A FLORISTIC INVENTORY OF PHILLIPS AND VALLEY COUNTIES, MONTANA (U.S.A.)

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ABSTRACT

This study marks the first floristic inventory of Phillips and Valley counties on the glaciated plains of northeastern Montana. The 23,191 sq km (8,954 sq mi) area was surveyed for all vascular plant taxa on lands managed by the Bureau of Land Management, U.S. Fish and Wildlife Service, State of Montana, American Prairie Reserve, and The Nature Conservancy. In the summers of 2010 and 2011, 12,768 voucher specimens were collected from 308 sites documenting 762 unique taxa, 718 species, and 358 genera from 86 families. Among these are 108 taxa exotic to Montana, nine noxious weed species, and 15 taxa of conservation concern. Approximately 30 percent of the taxa collected are newly documented within the area. An additional 70 taxa previously collected by other workers and housed at MONT, MONTU, or RM/USFS raised the total number of unique taxa to 832. Results are enumerated in an annotated checklist and vegetation types are described. Analyses of the study's sampling adequacy are also discussed.

RESUMEN

Este estudio marca el primer inventario florístico de los condados de Phillips y Valley de las llanuras glaciadas del noreste de Montana. El área de 23.191 km2 (8.954 sq mi) fue estudiada en busca de todos los taxa de plantas vasculares en los espacios manejados por el Bureau of Land Management, U.S. Fish and Wildlife Service, Estado de Montana, American Prairie Reserve, y The Nature Conservancy. En los veranos de 2010 y 2011, se colectaron 12.768 especimenes testigo de 308 lugares que documentan 762 taxa únicos, 718 especies, y 358 géneros de 86 familias. Entre estos se encuentran 108 taxa exóticos en Montana, nueve malas hierbas nocivas, y 15 taxa de preocupación en su conservación. Aproximadamente el 30 por ciento de los taxa colectados se documentan como nuevos en el área. 70 taxa adicionales previamente colectados por otros Investigadores y conservados en MONT, MONTU, o RM/USFS elevan el número total de taxa únicos a 832. Los resultados se enumeran en un catálogo anotado y se describen los tipos de vegetación. También se discuten los análisis la adecuación del muestreo.

INTRODUCTION

We report on a vascular plant inventory of public and private lands in Phillips and Valley counties in northeastern Montana (Fig. 1). The area is bound by Canada to the north, the Missouri River to the south, Daniels County and Fort Peck Indian Reservation to the east, and Blaine County and Fort Belknap Indian Reservation to the west. Elevation ranges from 616 to 1,743 m (2,020 to 5,720 ft).

The area is located within the North American Prairies floristic province near the edge of the Rocky Mountain province (Takhtajan 1986), although Lavin and Seibert (2011) have suggested that the area has a greater floristic affinity to the Intermountain region than to the Great Plains. Botanical exploration of the area began in 1805 and 1806 when the Lewis and Clark Expedition traveled along the Missouri River (Phillips 2003). Past treatments that have covered the area include Rydberg (1932; peripherally), *Atlas of the Flora of the Great Plains* (GPFA 1977), and *Flora of the Great Plains* (GPFA 1986). State floras include *Vascular Plants of Montana* (Dorn 1984) and the recently published *Manual of Montana Vascular Plants* (Lesica 2012). The area is one of many on the western Great Plains for which basic floristic knowledge has been lacking (GPFA 1986). Indeed, the area was not previously well collected: fewer than 1,200 collections from this area larger than the State of New Jersey are vouchered at the Montana State University Herbarium (MONT; 2013) and the University of Montana Herbarium (MONTU; 2013).

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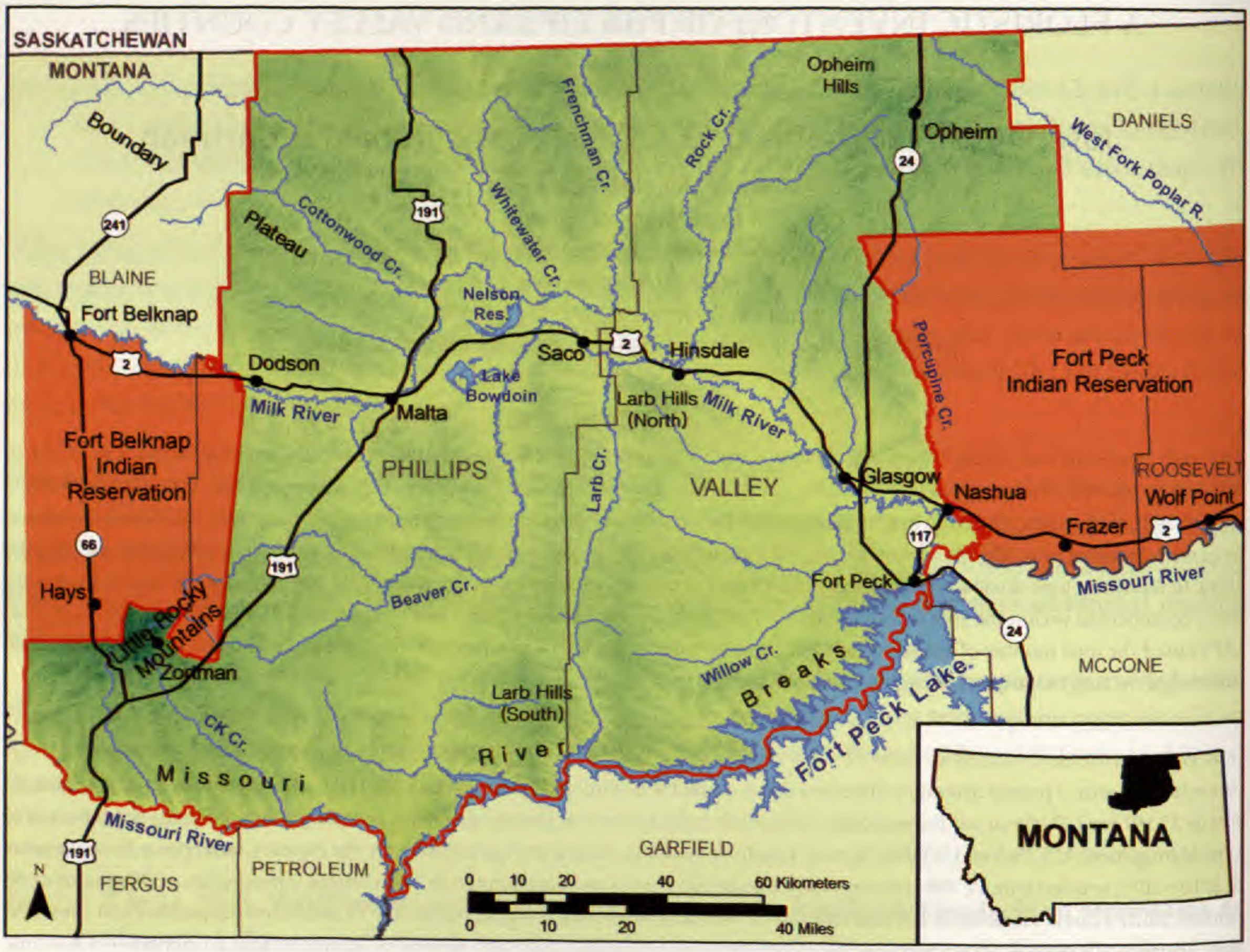

Fig. 1. General map of the study area (outlined in red), which comprises 23,191 sq km (8,954 sq mi) in northeastern Montana. Elevation ranges from 616–1,743 m (2,020–5,720 ft).

This botanical inventory is part of the larger effort by the Rocky Mountain Herbarium (RM) to map in relatively fine detail the geographic distributions of species based on vouchered specimens and to produce a flora of the greater Rocky Mountain region (Hartman 1992; Hartman & Nelson 2008; Hartman et al. 2009). Thus, floristic inventories (49 as master's degree projects) have been conducted during the past 34 years in Arizona, Colorado, Idaho, Kansas, Montana, Nebraska, New Mexico, Oregon, South Dakota, Utah, Washington, and Wyoming (e.g. Reif et al. 2009; Kesonie & Hartman 2011; Kuhn et al. 2011; Lukas et al. 2012). Over 650,000 new collections have been obtained by graduate students, staff, and research associates of RM. These specimens form the core of the RM Plant Specimen Database (835,000 specimen records, 55,000 specimen images, and 4,000 field images; Hartman et al. 2009).

Study area.—Various federal and state agencies manage lands in the area. In Phillips County, 4,374 sq km (1,689 sq mi) of Bureau of Land Management (BLM) lands are managed by the Malta BLM Field Office or in the southwest corner of the county as part of the Upper Missouri River Breaks National Monument, which is administered directly by the Montana/Dakotas BLM. The Glasgow BLM Field Office manages 4,095 sq km (1,581 sq mi) in Valley County. Also covered were 1,563 sq km (603 sq mi) of U.S. Fish and Wildlife Service lands including Charles M. Russell National Wildlife Refuge north of the Missouri River as well as Bowdoin National Wildlife Refuge. The area also includes 1,635 sq km (631 sq mi) managed by the state, mostly as Montana State Trust Lands or by Montana Fish, Wildlife, and Parks. Private lands visited include the American Prairie Reserve (133 sq km/51 sq mi) in southern Phillips County and the Matador Ranch (123 sq km/49 sq mi), owned and operated by The Nature Conservancy in southwestern Phillips County. In total, 11,924 sq km (4,604 sq mi)

were accessible for collection within the 23,191 sq km (8,954 sq mi) area (the entirety of Phillips and Valley counties exclusive of lands on the Fort Peck and Fort Belknap Indian Reservations). There are four wilderness study areas (WSAs) managed by the BLM: Bitter Creek WSA (239 sq km/92 sq mi) in northern Valley County, Burnt Lodge WSA (56 sq km/21 sq mi) in the Larb Hills (South), and Antelope Creek WSA (50 sq km/19 sq mi) as well as part of Cow Creek WSA (138 sq km/53 sq mi in total) in the Upper Missouri River Breaks National Monument. Grasslands National Park of Canada is located just north of the area in Saskatchewan.

Physiography.—The area is located on the Glaciated Missouri Plateau subregion of the northwestern portion of the Great Plains physiographic region (Fenneman 1916). Figure 1 shows topographic features and bodies of water in the area. The vast majority of the area was glaciated during the Pleistocene (Colton et al. 1961; Fullerton & Colton 1986). Most of the area lies on broadly rolling hills with typically dry drainages, locally called coulees. Grasses dominate these rolling hills with sagebrush (*Artemisia* spp.) abundant in some areas as well. Topographic relief is greater in the south on the Missouri River Breaks, where steep slopes can be covered with ponderosa pine woodlands. The Little Rocky Mountains, one of several forested island mountain ranges in central Montana, rise about 610 m (2,000 ft) above the surrounding plains in southwestern Phillips County and southeastern Blaine County. The summit of Antoine Butte at 1,743 m (5,720 ft) is the highest point in the Little Rockies and the area.

The entire area is located within the Missouri River watershed. Most of the area drains into the Milk River except several drainages in the south that lead directly to the Missouri River and part of northeastern Valley County, which is in the Poplar River watershed. The Milk River nearly bisects the area, entering in the west near Dodson and reaching its confluence with the Missouri River in the east (Fig. 1). The Missouri River is dammed near the town of Fort Peck by Fort Peck Dam, which was constructed by the U.S. Army Corps of Engineers during the 1930s (Bandy et al. 2004). Fort Peck Lake forms the shoreline of the Missouri River for much of its length within the area.

Climate.—The region has a cold semi-arid climate (BSk in the Köppen-Geiger climate classification; Peel et al. 2007), characterized by warm to hot summers and long cold winters (Bingham et al. 1984; Bandy et al. 2004; NCDC 2012). Average daily maximum temperatures range from 9.8 to 15.7°C (49.7 to 60.2°F), with the north cooler than the south (PRISM 2004). Average daily minimum temperatures range from -3.3 to 2.3°C (26.1 to 36.1°F), again generally lower in the north than in the south (PRISM 2004). Average annual precipitation is relatively low, ranging from 26.7 to 55.1 cm (10.5 to 21.7 in) in the Little Rocky Mountains (PRISM 2004). Areas of locally high elevations tend to receive more precipitation, including the Little Rockies. About half of the annual precipitation falls in the months of May, June, and July (NCDC 2012; WRCC 2012). Severe thunderstorms throughout the summer can bring locally heavy precipitation as well as damaging winds and hail (Bingham et al. 1984).

Precipitation was well above normal throughout most of the area in both field seasons of this inventory (2010 and 2011). Annual precipitation in 2010 at Glasgow was 46.0 cm (18.1 in; 156 percent of average) and in 2011 was 58.4 cm (23.0 in; 198 percent of average), the highest ever recorded in Glasgow (NCDC 2012; NWS 2012). In addition, the 275.8 cm (108.6 in) of snow that fell in Glasgow during the winter of 2010 and 2011 were the most ever recorded, more than three times greater than the average of 91 cm (36 in; NWS 2012). This abnormally high level of precipitation created excellent conditions for conducting a floristic inventory but brought extensive flooding as well.

Geology.—Three main events define the surficial geology of the area: the deposition of sedimentary rocks in a shallow inland sea during the Late Cretaceous, the formation of the Little Rocky Mountains during the early Paleogene, and the glaciation of nearly the entire area during the Pleistocene.

Throughout most of the area, the geologic layers exposed at the surface were deposited during the Late Cretaceous when a large, shallow, inland sea known as the Western Interior Seaway covered the region (Marshak 2005). Formations exposed from this time period are, from oldest to youngest, the Claggett shale, the Judith River formation, the Bearpaw shale, the Fox Hills sandstone, and the Hell Creek formation (Collier 1918; Vuke et al. 2007). The most commonly exposed of these Cretaceous-age materials is the Bearpaw shale (Vuke

et al. 2007). It consists of mostly dark-gray shale of marine origin and in some areas forms badlands and sticky clay soils known locally as gumbo (Collier 1918; Jensen & Varnes 1964). Localized bentonite layers in the Bearpaw shale, derived from volcanic ash deposits, have been mined in the area (Jensen & Varnes 1964; Bandy et al. 2004).

A structure called the Bowdoin dome exists in the central and northern portion of the area, centered about Nelson Reservoir and Lake Bowdoin (Bandy et al. 2004). Strata dip very slightly away from the center of the dome in all directions, which has resulted in weathering of younger overlying material and surface exposures of two older formations, the Claggett shale and the Judith River formation (Collier 1918; Vuke et al. 2007). The older Claggett shale, which outcrops at the center of the dome, consists of a dark-gray marine shale similar to the Bearpaw shale. The Judith River formation, which outcrops on the periphery of the dome, consists of sandstones and shale of a freshwater depositional environment (Collier 1918; Jensen & Varnes 1964). The Bowdoin dome has trapped natural gas in underlying Colorado Group sandstones (Bandy et al. 2004). Natural gas production from this dome has occurred since the early part of the 20th century and continues today (Bandy et al. 2004).

The Fox Hills sandstone and Hell Creek formation (famous for its dinosaur fossils; Jensen & Varnes 1964) outcrop in the southern part of the area as well as parts of northeastern Valley County (Collier 1918; Vuke et al. 2007). These consist of mostly sandstones (Bandy et al. 2004). The sandstones of the Hell Creek formation are more erosion resistant than the surrounding Bearpaw shale and often cap hills, particularly in the southern part of the area (Jensen & Varnes 1964).

The Flaxville gravel, derived from alluvial terrace deposits from the late Neogene and early Quaternary, is exposed in small parts of the north (Bandy et al. 2004). Resistant to erosion, it caps uplands and benches where it is exposed (Collier 1918). Alluvium from the Quaternary is present in the Milk River Valley and lower parts of larger creeks as well as on the Missouri River upstream of Fort Peck Lake (Bandy et al. 2004; Vuke et al. 2007).

The Little Rocky Mountains were formed during an early Paleogene orogeny in which intrusive igneous rocks uplifted Precambrian basement rocks and overlying Paleozoic and Mesozoic sedimentary rocks around the periphery of the range (Knechtel 1959). Precambrian metasedimentary and metavolcanic rocks outcrop along with igneous rocks in the center of the Little Rockies (Knechtel 1959; Bandy et al. 2004; Vuke et al. 2007). These igneous rocks at the core were intruded about 60 million years ago from alkaic magma (Wilson & Kyser 1988; Bandy et al. 2004). Gold and silver have been mined in the Little Rockies since 1884 in a variety of operations (Wilson & Kyser 1988; Bandy et al. 2004).

The sedimentary rocks overlying the Little Rocky Mountains were uplifted during the orogeny and subsequently have been eroded away over the core of the range, while remaining at the periphery (Knechtel 1959; Vuke et al. 2007). The most prominent strata exposed at the surface are erosion-resistant calcareous rocks from the Paleozoic, including dolomites of the Bighorn formation from the Ordovician, the Jefferson limestone of the Devonian, and especially the Lodgepole and Mission Canyon limestones of the Mississippian (Knechtel 1959). Mesozoic rocks outcrop mostly in the foothills surrounding the Little Rockies and in small areas within the range. These are mostly shales but also include some sandstones, conglomerates, and limestones (Knechtel 1959). Rocks from the Jurassic and Early Cretaceous are exposed in small areas around the periphery of the range but once on the plains, strata from the Upper Cretaceous dominate at the surface (Knechtel 1959; Vuke et al. 2007).

The Laurentide Ice Sheet covered the entire region during the late Illinoian glacial period (between 195,000 and 128,000 years ago) with the exception of the Little Rocky Mountains and an area east of Opheim within the Poplar River drainage (Colton et al. 1961; Fullerton & Colton 1986). Following this glacial period, extensive badlands formed subsequent to glaciation in the Wisconsinan (Fullerton & Colton 1986). Glaciers returned between 21,000 to 16,000 years ago during the late Wisconsinan, although to a much smaller extent than during the Illinoian (Fullerton & Colton 1986). During this time large areas remained ice-free in southern Phillips County, on the Boundary Plateau in northern Phillips County, and in much of Valley County, ex-

cluding the central portion (Colton et al. 1961; Fullerton & Colton 1986). Prior to these glacial episodes, the Missouri River formed the broad valley that the Milk River now meanders through (Collier 1918; Bingham et al. 1984; Bandy et al. 2004). Blocked by glacial ice, the Missouri River became entrenched in its current channel during the Wisconsinan (Collier 1918; Alden 1932).

Paleovegetation.—Vegetational history following deglaciation is somewhat uncertain because of a paucity of fossil pollen data from northern Montana (Barnosky 1989; Strong & Hills 2005). However, it is likely that after 12,000 years ago extensive grasslands similar to the present vegetation were established in the region, unlike areas further east and north, which supported long-standing wide bands of boreal forest following deglaciation (Strong & Hills 2005). Fossil pollen data from Guardipee Lake, Montana indicates that by 12,200 years ago, temperate grasslands with shrubs in mesic habitats were present in northern Montana east of the Rocky Mountains (Barnosky 1989). After 9,300 years ago these grasslands started to become more xeric as they are today (Barnosky 1989).

Less clear is the nature of the vegetation following the maximum extent of the Laurentide Ice Sheet about 20,000 years ago (Fullerton & Colton 1986) but prior to 12,000 years ago. There is no direct evidence for forests during this time, although the area may have been near the edges of both cordilleran and boreal forest belts. A dry deciduous boreal forest or aspen parkland may have existed south of the boreal/cordilleran forest zone in southern Saskatchewan (Klassen 1994), perhaps approaching northern Montana. The existence of a belt of cordilleran forests during this time may explain the distribution of these tree species in the island mountain ranges of central Montana and the Cypress Hills in Canada (Thompson & Kuijt 1976; Strong & Hills 2005). Presumably such a cordilleran forest belt stretched across the lowlands but was isolated after 14,000 years ago onto the discontinuous highlands of the region (Strong & Hills 2005), including the Little Rocky Mountains. Thompson and Kuijt (1976) believed this a more plausible explanation for the distribution of cordilleran conifers in the Cypress and Sweetgrass hills than long distance dispersal of seeds by wind or birds.

Soils and Agriculture.—Substrates are important in determining the distribution of plant species (Kruckeberg 2002), and in most of the area, soils rather than unweathered rocks are present at the surface. Many soils have developed from tills left following Illinoian and Wisconsinan glaciations. However, this till material is typically not far removed from its original source as the area was at the southern limit of the continental ice sheet and scouring power was minimal (Bandy et al. 2004). Therefore, these tills are derived primarily from Cretaceous shales. Tills are thickest in the northern part of the area, thinning to the south, or have been removed completely by erosion in some places (Bingham et al. 1984; Bandy et al. 2004). A few large glacial erratics have been deposited from as far away as the Hudson Bay (Collier 1918; Bandy et al. 2004).

Through their influence on vegetation, soils have also affected human settlement and agriculture. Soils developed from marine shales or their tills can be highly alkaline. This alkalinity combined with relatively low precipitation in the region make much of the land unsuited for cultivation (Cooper et al. 2001). Many homesteaders, who started to arrive following the establishment of the Great Northern Railway in 1887 (Bandy et al. 2004; now operated by the BNSF Railway), saw their farms go bankrupt during the Great Depression (Bingham et al. 1984). The BLM now manages many of these lands that were repurchased by the federal government under the Bankhead-Jones Farm Tenant Act of 1937 (Mackie 1970; Cooper et al. 2001). Today, most of the area is utilized for cattle grazing, and to a lesser extent, sheep grazing (Bandy et al. 2004). Dryland farming of small grains, including spring wheat, barley, and oats, as well as irrigated farming along the Milk River are still important as well (Bingham et al. 1984; Bandy et al. 2004). Today about 17 percent of the area is under cultivation (MTNHP 2010). The unsuitability of most of the area for cultivated agriculture and its use primarily as rangeland have left many of the grasslands and shrublands relatively intact (Cooper et al. 2001).

METHODS

The methods used for this inventory largely follow those employed by other graduate students and staff at RM for other floristic inventories in the greater Rocky Mountain region (Hartman 1992; Hartman & Nelson 2008; Reif et al. 2009; Kesonie & Hartman 2011; Kuhn et al. 2011; Lukas et al. 2012). Our primary objective was to

document the diversity of vascular plants across the area throughout the growing season through the collection of voucher specimens. As such, we chose individual collecting sites in the field rather than visiting a set of randomly distributed points. Collecting sites were selected for greatest potential diversity, often at the intersection of different vegetation types or on unique substrates, while spacing sites over the region during different months of the field season. At each collection site, we used the "meander" search strategy (Goff et al. 1982; Hartman 1992; Hartman & Nelson 2008). All species in flower or fruit or otherwise readily identifiable through vegetative characters were vouchered at each site visited and relevant habitat and location data (including GPS coordinates) were recorded. Specimens were collected within about 0.8 km (0.5 mi) of each recorded GPS point. Voucher specimens were collected, pressed, and dried in accordance with standard collecting techniques described in Hartman (1992) and Hartman and Nelson (2008).

Joseph L.M. Charboneau and B.E. Nelson made collections in the field seasons of 2010 and 2011. In 2010, we spent 53 person-days collecting between 8 June and 25 August and between 10 September and 21 September, generally alternating days collecting with days spent pressing. In 2011, between 10 May and 15 August, we spent 49 person-days collecting. In total, we made 12,768 collections from 308 sites at a density of 0.55 collections per sq km (1.43 per sq mi). Figure 2 contains a map of collection sites.

Specimens were identified using a number of floras including Dorn's *Vascular Plants of Montana* (1984), *Flora of the Great Plains* (GPFA 1986), Dorn's *Vascular Plants of Wyoming* (2001), and *Flora of North America* (1993+). All identifications were checked against specimens in RM verified by specialists. Nomenclature follows that of the RM Plant Specimen Database (Hartman et al. 2009). Specimen data have been entered into this database and are available online (Hartman et al. 2009). All specimens are housed at RM, and duplicates have been sent to MONT, MONTU, and other herbaria. We searched all databased records at MONT, MONTU, and RM/USFS (USFS is the National Herbarium of the U.S. Forest Service, integrated with RM; Hartman et al. 2009; MONT 2013; MONTU 2013) from the area for taxa we did not collect as part of this study but were collected by others and personally verified the identification of these specimens. These "historical" taxa are included within the annotated checklist.

We described 19 vegetation types organized into six physiognomic categories based on the dominant vegetation of each type, taking inspiration from the Montana Ecological Systems Field Guide (MTNHP 2012a). These descriptions are based on our field notes, and the species listed in our vegetation type descriptions were the most commonly collected within each type.

We performed two types of analyses to assess the adequacy of our collecting in documenting the actual diversity of vascular plants. The first was a comparison of the environmental conditions and cover types sampled by our collection sites and a set of randomly placed points based on the non-stratified environmental parameter analysis described by Neldner et al. (1995). Using ArcGIS v. 10.0 (ESRI 2011) we classified ranges of three environmental variables across the area: elevation (USGS 2009), average annual precipitation, and average daily minimum temperature (PRISM 2004). We then created a raster file with combinations of these classes and determined how many combinations were sampled by our collection sites and a set of random points within the same accessible lands we collected. We also repeated this analysis using land cover type data from MTNHP (2010) in place of the environmental data.

The second type of analysis used to evaluate our sampling adequacy was a comparison of the vascular plant diversity we observed to estimates of the true diversity present. We used EstimateS v. 9.1 (Colwell 2013) to make taxon accumulation curves by collection days elapsed both chronologically and from 100 randomizations of collecting order using the default settings. For this purpose we used all collections that were definitively identified even if they were eventually discarded for inadequate material. We estimated the total vascular plant diversity using both the non-parametric, asymptote-fitting Michaelis-Menten equation and parametric richness estimators (i.e. based on the number of taxa collected only once or twice) such as the bootstrap, second-order jackknife, and Chao 1 estimators (see Colwell & Coddington 1994 for a review of these methods). We compared these estimates of actual taxon diversity to the number of observed taxa to estimate the percentage of actual taxon diversity documented.

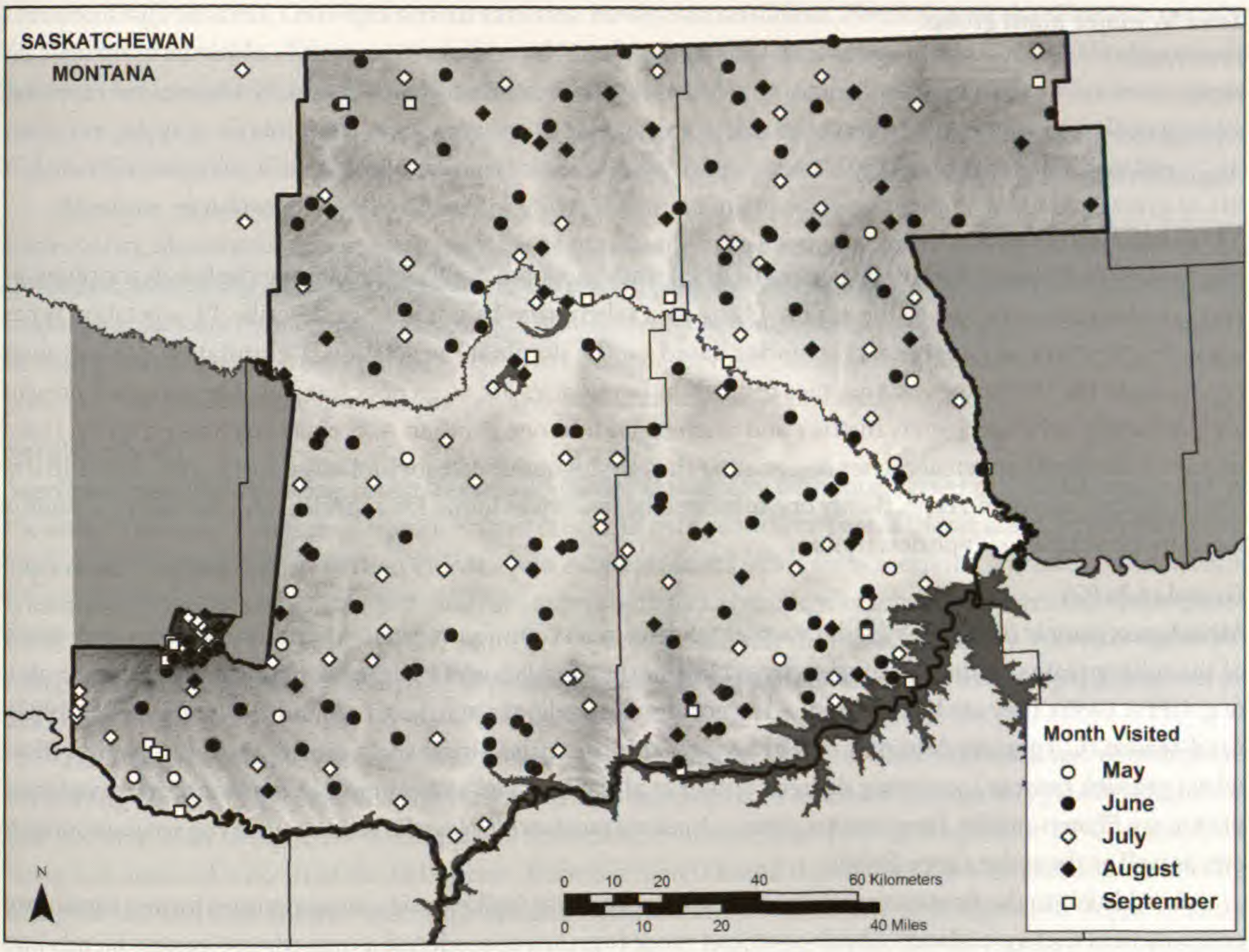

FIG. 2. Collection sites depicted by month visited. Specimens were collected from 308 sites in 2010–2011 primarily in Phillips and Valley counties. The study area is outlined in black.

RESULTS AND DISCUSSION

Results of the inventory are included in the following sections: summary of taxa, vegetation types, taxa of conservation concern, exotic taxa and noxious weeds, newly documented taxa, and sampling adequacy.

Summary of Taxa

We collected 762 unique taxa from 86 vascular plant families. The families with the highest diversity are Asteraceae (134 taxa), Poaceae (111), Fabaceae (55), Brassicaceae (39), and Rosaceae (37). Genera with the greatest number of taxa observed are *Carex* (Cyperaceae; 21 taxa), *Astragalus* (Fabaceae; 19), *Elymus* (Poaceae; 18), *Poa* (Poaceae; 11), and *Potentilla* (Rosaceae; 11). Below is a summary of the plants collected during the study. Seventy "historical" taxa housed at MONT, MONTU, or RM/USFS were located from an additional four families, 22 genera, and 68 species, bringing the total number of unique taxa to 832. Numbers in parentheses below are totals including taxa collected by other workers.

Taxa by taxonomic category:			Taxa by special category:		
Families	86	(90)	Exotic	108	(133)
Genera	358	(380)	Percent exotic taxa	14.2	(16.0)
Species	718	(786)	MT noxious weeds	10	(12)
Infraspecies	43	(45)	Of conservation concern	15	(20)
Putative hybrids	1	(1)	New to study area	227	
Unique taxa	762	(832)	County records	446	

Taxa by major plant group:

Fern Allies	7	(7)
Ferns	7	(8)
Gymnosperms	7	(7)
Angiosperms	741	(810)

VEGETATION TYPES

Mackie (1970), Roberts (1980), Hansen et al. (1995), and Cooper et al. (2001) are among the few descriptions of plant communities specific to the region. Using data taken from field notes, we describe 19 vegetation types organized into six physiognomic categories based on the dominant vegetation. Delimitation of vegetation types across the landscape is sometimes difficult as boundaries are often not clear-cut. The types we present are not meant to be completely distinct and often blend into one another. Abbreviations for vegetation types consist of an initial uppercase letter designating the physiognomic category followed by two lowercase letters for the unique vegetation type. If only one infraspecific taxon was found for a species, only the species name is listed in the vegetation type description.

Grasslands (G)

Mixedgrass prairie (Gmg).—Mixedgrass prairie is the most common vegetation type, dominating over much of the rolling plains. Although some sources classify the grasslands of eastern Montana as shortgrass prairie (e.g. GPFA 1986), they are better classified as northern mixedgrass prairie (Coupland 1961; Singh et al. 1983). Cool-season (C_3) grasses dominate this mixedgrass prairie with a single short, warm-season (C_4) grass (*Bouteloua gracilis*) present to varying degrees (Singh et al. 1983). Cool-season grasses dominant in mixedgrass prairie are *Elymus smithii*, *Hesperostipa comata*, *Koeleria macrantha*, *Nassella viridula*, and *Poa secunda* subspecies as well as the sedge *Carex filifolia*.

In addition to the dominance of grasses, *Selaginella densa* (spikemoss) can sometimes form a significant component of these grasslands. Shrub cover can range from low to moderate as mixedgrass prairie blends into sagebrush steppe. Shrubs commonly found are *Artemisia cana*, *A. tridentata*, *Juniperus horizontalis*, and *Krascheninnikovia lanata* along with the cactus *Opuntia polyacantha* and the subshrub *A. frigida*. Forb diversity is relatively high in mixedgrass prairie. *Achillea millefolium*, *Allium textile*, *Antennaria* spp., *Astragalus* spp., *Boechera collinsii*, *Collomia linearis*, *Erigeron pumilus*, *Erysimum inconspicuum*, *Hedeoma hispidum*, *Heterotheca villosa*, *Hymenoxys richardsonii*, *Lomatium foeniculaceum*, *Oenothera suffrutescens*, *Packera cana*, *Pediomelum argophyllum*, *Penstemon* spp., *Phlox hoodii*, *Plantago patagonica*, *Ratibida columnifera*, *Sphaeralcea coccinea*, *Vicia americana* var. *minor*, and the exotic *Tragopogon dubius* are commonly found.

The area's flora is more greatly influenced by regions to the west rather than by the eastern edge of the Great Plains (Lavin & Seibert 2011). Grasses of the tallgrass or "true" prairie such as *Andropogon gerardii* Vitman, *Hesperostipa spartea* (Trin.) Barkworth, *Panicum virgatum* L., *Sorghastrum nutans* (L.) Nash, and *Sporobolus heterolepis* (A. Gray) A. Gray (Johnson & Larson 2007) indeed are entirely absent. But to say that the area is little influenced by the Great Plains flora as indicated by Lavin and Seibert (2011) is dependent on how one defines this flora. The Great Plains flora is in all parts recent and adventive, with species colonizing from peripheral ecosystems (GPFA 1986).

A variant of mixedgrass prairie occurs in the north where mesic grasslands on soils derived from fine-grained till are dominated by *Hesperostipa curtiseta* and *Elymus lanceolatus* varieties (Coupland 1961; Cooper et al. 2001). This association will be discussed further with the moist coulee bottom and swale vegetation type.

Upland prairie (Gup).—Well-drained prairie uplands often have a distinctive suite of species in addition to those common on typical mixedgrass prairie. Sandstone outcrops and sandstone-derived soils are often present on uplands since sandstone erodes less easily than shale in this semiarid environment (Jensen & Varnes 1964). Thus many uplands often have sandier soil than surrounding areas. On these uplands, forbs such as *Astragalus gilviflorus*, *Comandra umbellata*, *Cryptantha celosioides*, *C. spiculifera*, *Dalea candida*, *Eriogonum* spp., *Heterotheca villosa*, *Hymenopappus filifolius*, *Hymenoxys richardsonii*, *Lithospermum incisum*, *Lupinus pusillus*,

Oenothera suffrutescens, *Oxytropis sericea* varieties, *Paronychia sessiliflora*, *Penstemon nitidus*, *Physaria spatulata*, *Stenotus armerioides*, *Tetraneuris acaulis*, and *Xanthisma grindelioides* are common. Typical shrubs include *Juniperus horizontalis*, *Krascheninnikovia lanata*, *Rhus trilobata*, *Yucca glauca*, and the subshrub *Artemisia campestris* var. *pacifica*. Graminoids often growing in this habitat are *Achnatherum hymenoides*, *Bouteloua gracilis*, *Calamovilfa longifolia*, *Carex filifolia*, *Elymus spicatus*, *Hesperostipa comata*, and *Schizachyrium scoparium*.

Montane meadows (Gmm).—There are only a few montane meadows found on south exposures in the Little Rocky Mountains. These often have many grassland species found at lower elevations but also have a distinctive assemblage of forbs. Diagnostic forbs include *Balsamorhiza sagittata*, *Delphinium bicolor*, *Drymocallis glabrata*, *Lithospermum ruderale*, *Oxytropis splendens*, and *Solidago mollis*. Some diagnostic graminoids are *Bromus porteri*, *Calamagrostis purpurascens*, *Carex hoodii*, *C. rossii*, *Festuca saximontana*, and the exotic *Poa pratensis*. The shrub *Dasiphora fruticosa* can also be found in these open meadows.

Shrublands (S)

Sagebrush steppe (Sss).—Sagebrush steppe intergrades extensively with mixedgrass prairie, sharing many of the same graminoid and forb species. It is most prevalent in the southern part of the area. Sagebrush (*Artemisia* spp.) cover is dependent in part on climatic and edaphic factors, with areas receiving a greater proportion of winter precipitation and greater soil moisture at depth likely to have higher sagebrush cover than pure grasslands (Knight 1994). Fires also greatly influence sagebrush cover. It may take more than 100 years for Wyoming big sagebrush cover to return to pre-burn levels in eastern Montana sagebrush steppe (Cooper et al. 2011).

There are two primary sagebrush taxa forming sagebrush steppe: *Artemisia tridentata* var. *wyomingensis* (Wyoming big sagebrush) and *A. cana* var. *cana* (silver sagebrush). *Artemisia tridentata* is typically is found on fine-textured soils (Knight 1994) and is at its northeastern limit within the area (McArthur 1999), indeed, we never encountered it north of the Milk River. *Artemisia cana* is found throughout the area and is more tolerant of higher soil moisture than *A. tridentata* (Knight 1994) and as such can often form sagebrush steppe in moist coulees. *Artemisia cana* is also found in sandier soil than *A. tridentata* and is able to resprout after fires and other disturbances unlike *A. tridentata* (Knight 1994).

Ericameria nauseosa var. *nauseosa* is another common shrub in sagebrush steppe along with the subshrubs *Artemisia frigida*, *Atriplex gardneri* var. *gardneri*, *Gutierrezia sarothrae*, and the cactus *Opuntia polyacantha*. Typical graminoids are *Bouteloua gracilis*, *Elymus elymoides* varieties, *E. smithii*, *Hesperostipa comata*, *Koeleria macrantha*, *Nassella viridula*, *Poa secunda* subspecies, and the exotic grass *Bromus japonicus*. Forbs commonly found in sagebrush steppe include *Achillea millefolium*, *Allium textile*, *Antennaria parvifolia*, *Astragalus missouriensis*, *Atriplex argentea*, *Dalea purpurea*, *Erigeron pumilus*, *Grindelia squarrosa*, *Heterotheca villosa*, *Musineon divaricatum*, *Orobanche fasciculata*, *Pediomelum argophyllum*, *Plantago patagonica*, *Ratibida columnifera*, *Senecio integerrimus* var. *scribneri*, *Vicia americana* var. *minor*, and the exotic *Tragopogon dubius*. As in mixedgrass prairie, *Selaginella densa* can form significant ground cover as well.

Juniper steppe/woodland (Sjw).—This vegetation type is transitional between sagebrush steppe and ponderosa pine-juniper woodland, overlapping both considerably. It is found only in the south along the Missouri River Breaks where *Juniperus scopulorum* (Rocky Mountain juniper), *J. horizontalis* (creeping juniper), and their conspecific hybrid, *J.* ×*fassettii*, occur relatively sparsely on hillsides and coulees. *Juniperus*×*fassettii* (also known as *J. scopulorum* Sarg. var. *patens* Fassett) is a decumbent shrub intermediate in stature between the parental species that lacks the single-stemmed crown of *J. scopulorum* and the completely prostrate habit of *J. horizontalis* (Adams 2011). Other common shrubs include *Artemisia tridentata* and *Rhus trilobata*.

Greasewood shrubland (Sgs).—Shrublands dominated by *Sarcobatus vermiculatus* (greasewood) are often found toward the bottom of coulees on soils derived from marine shales where there are saline soils and a high water table (MTNHP 2012a). *Artemisia tridentata* is another common shrub in the fine-textured soils of this vegetation type along with subshrubs *Atriplex gardneri* var. *gardneri*, *Gutierrezia sarothrae*, *Suaeda calceoliformis*, and the cactus *Opuntia polyacantha*. The forbs *Atriplex suckleyi*, *Dieteria canescens*, *Grindelia squarrosa*, *Helianthus annuus*, *Iva axillaris*, *Musineon divaricatum*, *Plantago elongata*, *Sphaeralcea coccinea*, *Vicia ameri-*

cana var. *minor* are typically found along with exotics *Melilotus officinalis*, *Polygonum aviculare*, and *Tragopogon dubius*. Common grasses include *Bouteloua gracilis*, *Distichlis spicata*, *Elymus elymoides* var. *elymoides*, *E. smithii*, *Hordeum jubatum* ssp. *intermedium*, and the exotic grass *Bromus japonicus*. Sagebrush steppe and juniper steppe/woodland often intergrade into these greasewood shrublands from upslope.

Forests and Woodlands (F)

Thicket and woody draw (Ftw).—In steep coulees there is enough moisture to support thickets primarily of shrubs, especially Prunus virginiana, Rhus trilobata, and Shepherdia argentea but also Amelanchier alnifolia, Cornus sericea, Juniperus spp., Ribes spp., Rosa woodsii, Symphoricarpos occidentalis, and Toxicodendron rydbergii. In the steepest, moistest coulees, trees such as Acer negundo var. interius, Fraxinus pensylvanica, Juniperus scopulorum, and Populus deltoides can be found. Typical grasses in these thickets are Elymus canadensis, E. trachycaulus var. trachycaulus, Nassella viridula, Piptatherum micranthum, and exotics Bromus inermis and Poa pratensis. Forbs such as Astragalus agrestis, Campanula rotundifolia, Geum triflorum, Glycyrrhiza lepidota, Maianthemum stellatum, Parietaria pensylvanica, Solidago missouriensis, and Urtica dioica are often found along with exotics Camelina microcarpa and Fallopia convolvulus. Wooded draws with Fraxinus pensylvanica are presently experiencing reduced seedling recruitment and have been declining in quality across eastern Montana due to the effects of overgrazing and the invasion of exotic grasses such as Bromus inermis and Poa pratensis (Lesica & Marlow 2013).

Riparian cottonwood forest (Frc).—Similar to woody draws and thickets, these riparian forests dominated by *Populus deltoides* (cottonwood) are found along the flood plains of the Milk and Missouri rivers and a few larger creeks. Other trees sometimes found in these riparian forests are *Acer negundo* var. interius, *Fraxinus pensylvanica*, and *Salix amygdaloides*, along with the exotic tree *Elaeagnus angustifolia*. Typical shrubs are *Prunus virginiana*, *Rosa woodsii*, *Salix eriocephala* var. *famelica*, *S. exigua* ssp. *interior*, *Symphoricarpos occidentalis*, and the subshrub *Artemisia dracunculus*. Fluctuating water levels and livestock disturb these forests so weedy grasses such as exotics *Bromus inermis*, *Eragrostis cilianensis*, *Setaria viridis*, and natives *Echinochloa muricata* and *Panicum capillare* are often found along with weedy forbs including exotics *Euphorbia esula* varieties and *Kochia scoparia*. Also commonly found are *Artemisia ludoviciana*, *Chamaesyce glyptosperma*, *Glycyrrhiza lepidota*, and *Solidago gigantea*. In many of these forests, human alteration of hydrology has resulted in highly altered, old cottonwood stands with limited regeneration since high water events are necessary for the recruitment of new seedlings (Auble & Scott 1998). Flooding during 2011, however, resulted in the establishment of many new cottonwood seedlings on the banks of the Milk and Missouri rivers.

Ponderosa pine-juniper woodland (Fpj).—This habitat occurs only in parts of the Missouri River Breaks on steep drainages. The upper canopy is typically fairly open and composed of *Pinus ponderosa* (ponderosa pine), although *Pseudotsuga menziesii* (Douglas fir) may also be found on some of the steepest north exposures in southern Phillips County. Typically there is also a thick understory of junipers, both *Juniperus scopulorum* and *J.* ×*fassettii*. Surrounding vegetation types like sagebrush steppe and juniper steppe/woodland heavily influence ponderosa pine-juniper woodland vegetation. *Artemisia tridentata*, *Juniperus communis*, *Ribes cereum*, *Rhus trilobata*, and *Symphoricarpos occidentalis* are common shrubs. Graminoids such as *Achnatherum hymenoides*, *Carex inops*, *Elymus smithii*, *E. spicatus*, *Nassella viridula*, *Poa secunda* subspecies, and the exotic grass *Bromus japonicus* are typically found. *Achillea millefolium*, *Parietaria pensylvanica*, *Pediomelum argophyllum*, *Phacelia linearis*, *Thermopsis rhombifolia* var. *rhombifolia*, and the exotic *Tragopogon dubius* are common forbs. Many of these woodlands and surrounding sagebrush steppe have a heavy cover of the exotic *Melilotus officinalis*, which was often seeded by land managers in revegetation projects even though it can be highly invasive on the Northern Great Plains (Lesica & DeLuca 2000). In addition to shading out native vegetation, *M. officinalis* may allow other non-native plants to outcompete native ones by enriching soils with nitrogen (Lesica & DeLuca 2000).

Montane ponderosa pine forest (Fpp).—These forests are found only in the Little Rocky Mountains in dry areas at low elevations. Montane ponderosa pine forests occur from about 1,130 to 1,310 m (3,700 to 4,300 ft) where they begin to transition into lodgepole pine forests. Above these elevations, ponderosa pine is more

scarce and usually only on sunny, south exposures. Ponderosa pine is at the northern edge of its range within the area. In the Cypress Hills (in Canada) and the Sweetgrass Hills, only about 100 km (60 mi) further north than the Little Rockies, ponderosa pine is absent, apparently because the climate is too cold (Breitung 1954; Thompson & Kuijt 1976; USGS 1999).

Pinus ponderosa is the dominant tree in these forests with *Juniperus scopulorum* present in the understory. The understory also includes such shrubs as *Arctostaphylos uva-ursi*, *Berberis repens*, and *Juniperus communis* along with the subshrub *Artemisia campestris* var. *pacifica*. Representative grasses are *Danthonia spicata*, *Elymus albicans*, *E. trachycaulus* var. *trachycaulus*, and the exotic *Poa compressa*. The suite of forbs found in these montane forests is quite different from those found in the ponderosa pine-juniper woodlands of the Missouri River Breaks. *Anemone multifida*, *A. patens*, *Allium cernuum*, *Cerastium arvense*, *Cirsium undulatum*, *Fragaria virginiana*, *Gaillardia aristata*, *Helianthus pauciflorus*, *Maianthemum stellatum*, *Monarda fistulosa*, *Pterospora andromedea*, *Solidago simplex*, and *Viola adunca* are typical forbs.

Montane mixed conifer forest (Fmc).—This forest type is found in the Little Rocky Mountains on mesic slopes at middle elevations. Tree canopy is made up of a mixture of the conifers *Pinus contorta* (lodgepole pine), *P. ponderosa*, and *Pseudotsuga menziesii* along with the deciduous tree *Populus tremuloides* (quaking aspen). Common shrubs are *Arctostaphylos uva-ursi*, *Berberis repens*, *Juniperus communis*, and *Shepherdia canadensis*. Representative grasses found in these forests are *Danthonia spicata*, *Elymus spicatus*, *Poa interior*, and exotics *E. repens* and *Phleum pratense*. Typical forbs include *Achillea millefolium*, *Campanula rotundifolia*, *Clematis occidentalis*, *Gaillardia aristata*, *Galium boreale*, *Linnaea borealis*, *Maianthemum racemosum*, *Moehringia lateriflora*, *Monarda fistulosa*, *Osmorhiza chilensis*, *Prosartes trachycarpa*, *Pterospora andromedea*, and the exotic *Medicago lupulina*.

Lodgepole pine forest (Flp).—Lodgepole pine forests are found in the Little Rockies in dry areas at high elevations. These forests typically have a closed canopy and an understory depauperate of species. Moderate disturbance can add some diversity to these forests, but following fires, thick "doghair" stands of young trees sprout from serotinous cones (Knight 1994). Such stands are common in the Little Rockies. Mountain pine beetle infestations in these and other forests in the Little Rocky Mountains are minimal at this time. Shrubs found in lodgepole pine forests are *Ceanothus velutinus*, *Juniperus communis*, *Rosa nutkana*, *Salix scouleriana*, and *Shepherdia canadensis*. Other species commonly found include *Galium boreale*, *Linnaea borealis*, *Orthilia secunda*, *Pterospora andromedea*, *Spiraea betulifolia*, and *Thermopsis rhombifolia* var. *rhombifolia*. There are no subalpine forests found in the Little Rockies. *Picea engelmannii* Parry ex Engelm. (Engelmann spruce) has been reported in the nearby Bearpaw Mountains (USGS 1999), which rise to a maximum elevation of 2,108 m (6,917 ft), nearly 365 m (1,200 ft) higher than the Little Rockies.

Montane riparian forest (Fmr).—This forest type is found along moist creek bottoms in the Little Rocky Mountains, and we have included wetland species found in and along mountain creeks under this vegetation type. Mixed conifers (*Pinus contorta*, *P. ponderosa*, and *Pseudotsuga menziesii*) form the canopy with a thick understory of the deciduous trees *Betula papyrifera* (paper birch) and *Populus tremuloides* and the shrubs *Amelanchier alnifolia*, *Cornus sericea*, *Juniperus communis*, *Prunus virginiana*, *Ribes* spp., *Salix bebbiana*, and *Shepherdia canadensis*. Typical grasses are *Bromus richardsonii*, *Poa palustris*, and exotics *B. inermis*, *Phleum pratense*, and *Poa pratensis*. Common forbs include *Achillea millefolium*, *Actaea rubra*, *Agrimonia striata*, *Clematis occidentalis*, *Equisetum arvense*, *Galium boreale*, *G. triflorum*, *Geranium richardsonii*, *Heracleum maximum*, *Hieracium umbellatum*, *Linnaea borealis*, *Maianthemum racemosum*, *Mimulus guttatus*, various orchids, *Prosartes trachycarpa*, *Pyrola asarifolia*, *Sanicula marilandica*, *Spiraea betulifolia*, *Symphyotrichum ciliolatum*, *Viola canadensis*, and the exotic *Cirsium vulgare*. The presence of paper birch in the Little Rockies suggests the presence of boreal forests in the region following Pleistocene glaciations. Most of the flora of the Little Rockies, however, is more indicative of a cordilleran influence as in the Sweetgrass Hills (Thompson & Kuijt 1976) and to a lesser extent the Cypress Hills (Breitung 1954).

Wetlands (W)

Moist coulee bottom and swale (Wcb).—Some prairie species are most typically found in moist coulee bottoms and swales. This habitat also grades into thickets and wooded coulees if there is enough moisture to support

more woody vegetation and into persistent wetlands if there is surface water. Common forbs in moist coulee bottoms and swales include *Achillea millefolium*, *Arnica fulgens*, *A. sororia*, *Artemisia ludoviciana*, *Cerastium arvense*, *Geum triflorum*, *Glycyrrhiza lepidota*, *Grindelia squarrosa*, *Orthocarpus luteus*, *Potentilla* spp., *Thermopsis rhombifolia* var. *rhombifolia*, *Veronica peregrina*, and *Zigadenus venenosus* along with exotics *Draba nemorosa*, *Thlaspi arvense*, and *Tragopogon dubius*. Common graminoids are *Carex brevior*, *C. praegracilis*, *Hordeum jubatum* subspecies, *Juncus arcticus*, *Nassella viridula*, and the exotic *Poa pratensis*. The shrubs *Artemisia cana*, *Juniperus horizontalis*, *Rosa woodsii*, and *Symphoricarpos occidentalis* can also be found.

Distinct from moist coulee bottoms and swales, vernal pools with seasonally standing water can be found in otherwise flat topography. *Eleocharis acicularis*, *E. palustris*, *Gnaphalium palustre*, *Myosurus minimus*, *Navarretia saximontana*, *Plagiobothrys leptocladus*, *P. scouleri*, and *Veronica peregrina* are commonly found in vernal pools. Several of the taxa of conservation concern we found grow in these vernal pools as well.

The coulee bottoms and mesic grasslands in the north, particularly in northeastern Valley County, seem to be indicative of vegetation types more common to the north in Canada. In the Opheim Hills and to the east, the shrubs *Dasiphora fruticosa* and *Elaeagnus commutata* can also be found in moist swales. *Populus tremuloides*, rare on the plains of eastern Montana but more common further north in Canada (Coupland 1961; Cooper et al. 2001), can be found in some of the coulees of the Opheim Hills and northeastern Phillips County as well. A few species found nowhere else were present in these moist habitats: *Carex obtusata*, *Fragaria vesca*, *Geranium viscosissimum*, *Primula pauciflora*, *Viola nephrophylla*, and *Zizia aptera*. Many of these species are more common on the Canadian prairies further north (Budd 1979). Other species were only encountered elsewhere in the Little Rockies including *Carex bebbii*, *C. sprengelii*, *Delphinium bicolor*, *Heracleum maximum*, *Shepherdia canadensis*, and *Viola canadensis*. The grasses *Elymus lanceolatus* varieties and *Hesperostipa curtiseta* were also frequently found in these locations. *Festuca hallii*, the principal grass of the fescue prairies of Canada (Coupland 1961), was found only once in the study in northeastern Valley County just a few miles south of Canada. This area receives slightly greater precipitation and is generally colder than the rest of the area (PRISM 2004).

The *Hesperostipa curtiseta-Elymus lanceolatus* grasslands found in northeastern Valley County are much more common in Canada than in the U.S. However, they were once more prevalent in both countries before such sites, which are well suited to grain production, were put under cultivation (Cooper et al. 2001). Indeed, most of the lands east of Opheim are in cultivation and privately owned. A sizable expanse of this prairie association in a large area of Montana State Trust Lands along Dry Fork Creek in northern Valley County represents one of, if not the best, remaining of its kind in the U.S. (Cooper et al. 2001).

Persistent wetland (Wpw).—Most persistent wetlands are located around small reservoirs although they also occur along large creeks and small pools in creek beds where open water persists throughout the growing season. Around the periphery of wetlands, which may be submerged in the spring and early summer but are often dry by autumn, graminoids such as *Beckmannia syzigachne*, *Carex* spp., *Echinochloa muricata*, *Eleocharis acicularis*, *E. palustris*, *Hordeum jubatum* subspecies, *Juncus arcticus*, *Poa palustris*, and the exotic grass *Polypogon monspeliensis* are common along with the forbs *Conyza canadensis*, *Glycyrrhiza lepidota*, *Lycopus asper*, *Mentha arvensis*, *Rumex* spp., exotic *Sonchus arvensis* and the noxious weed *Cirsium arvense*. Common shrubs on the periphery of wetlands are *Rosa woodsii* and *Salix exigua* ssp. *interior*. Occasionally the trees *Populus deltoides* and *Salix amygdaloides* may occur as well. Emergent aquatic plants typically growing in standing water throughout the growing season are *Alisma gramineum*, *A. triviale*, *Bolboschoenus fluviatilis*, *B. maritimus*, *Limosella aquatica*, *Persicaria amphibia*, *P. lapathifolia*, *Sagittaria cuneata*, *Schoenoplectus* spp., *Typha angustifolia*, and *T. latifolia*. Common submerged aquatics are *Ceratophyllum demersum*, *Potamogeton* spp., *Ranunculus aquatilis*, and *Stuckenia pectinata*.

Alkaline wetland (Wal).—Many wetlands are alkaline at least to some extent because soils in most of the area are derived from marine shales. Many species found in freshwater wetlands are also found in alkaline wetlands but the most alkaline typically have a unique assemblage including *Distichlis spicata*, *Glaux maritima*, *Hordeum jubatum* subspecies, *Iva axillaris*, *Juncus arcticus*, *Puccinellia nuttalliana*, *Salicornia rubra*, *Spergularia marina*, *Triglochin maritima*, the subshrub *Suaeda calceoliformis* and the exotic *Polygonum aviculare*.

Sparsely vegetated alkaline pan areas are also common. These pan areas are formed above high points on the shale-till boundary beneath the soil surface. Salts from marine shales accumulate here and cause the formation of natric horizons in the subsoil, which greatly reduces infiltration of precipitation (Munn & Boehm 1983). Few plants can thrive in these water-stressed, alkaline conditions, so plant cover is very sparse with low diversity. *Atriplex suckleyi*, *Dieteria canescens*, *Distichlis spicata*, *Elymus smithii*, *Hordeum jubatum* subspecies, *Iva axillaris*, *Monolepis nuttalliana*, *Oenothera cespitosa*, *Puccinellia nuttalliana*, the exotic *Polygonum aviculare*, and the subshrub *Atriplex gardneri* var. *gardneri* are among the few species typically encountered.

Sparsely Vegetated (V)

Badlands (Vbl).—Badlands are common where marine shales are exposed. When wetted, these badlands form slick, alkaline clay that cracks extensively upon drying and erodes so rapidly that little vegetation can be established. The few species that can survive on badlands are often ruderal and tolerant of alkalinity. These include *Atriplex argentea*, *A. suckleyi*, *Eriogonum pauciflorum*, *Iva axillaris*, *Monolepis nuttalliana*, *Oenothera cespitosa*, *Penstemon nitidus*, and exotics *Conringia orientalis* and *Polygonum aviculare* occasionally with subshrubs *Atriplex gardneri* var. *gardneri*, *Suaeda calceoliformis*, and the shrub *Sarcobatus vermiculatus*.

Shale dunes, somewhat similar to badlands but less common, are found especially in the north in Bitter Creek WSA and the Frenchman Creek valley. These dunes are formed by the wind when shale weathers into sand-sized particles or small, thin flakes rather than clay minerals. *Juniperus horizontalis* typically stabilizes these dunes. Other species commonly found are *Artemisia longifolia*, *Eriogonum pauciflorum*, *Oenothera cespitosa*, *Rosa* spp., *Stephanomeria runcinata*, and *Thermopsis rhombifolia* var. *rhombifolia*.

Rock outcrops and talus (Vot).—The Little Rocky Mountains have areas of both granitic and carbonate rock outcrops. Chamerion angustifolium var. angustifolium, Cheilanthes feei, Draba cana, Erigeron compositus, Eriogonum ovalifolium var. purpureum, Minuartia rubella, Poa glauca, Sedum lanceolatum, Townsendia hookeri, and Woodsia oregana are among the herbaceous species found on these outcrops. The shrubs Dasiphora fruticosa and Ribes cereum can be found as well.

There are also several large areas of sparsely vegetated talus fields in the Little Rockies. *Ceanothus velutinus*, *Chamerion angustifolium* var. *canescens*, *Prunus pensylvanica*, *Ribes cereum*, *R. oxyacanthoides* var. *oxyacanthoides*, and *Rubus idaeus* are typically found on this talus.

Disturbed (D)

There are many disturbed habitats covered by ruderal forbs and grasses (many are invasive). These are primarily found along roadsides but also in dry reservoir beds, on reservoir dams, and in reseeded fields. Areas disturbed by natural action such as fires, flooding, and animal burrows have many of the same species. Typical exotic forbs of these habitats include *Alyssum desertorum*, *Camelina microcarpa*, *Descurainia sophia*, *Kochia scoparia*, *Lactuca serriola*, *Lappula occidentalis*, *Medicago lupulina*, *M. sativa*, *Melilotus officinalis*, *Polygonum aviculare*, *Salsola tragus*, *Thlaspi arvense*, *Tragopogon dubius*, and the noxious weed *Convolvulus arvensis*. Natives *Chamaesyce* spp., *Chenopodium berlandieri*, *Grindelia squarrosa*, *Helianthus annuus*, *Lepidium densiflorum* varieties, *Monolepis nuttalliana*, *Plantago patagonica*, *Polygonum achoreum*, and *Verbena bracteata* are common in disturbed habitats as well. Typical weedy grasses are the exotics *Agropyron cristatum* varieties, *Bromus inermis*, *B. japonicus*, *B. tectorum*, *Eragrostis cilianensis*, *Poa pratensis*, and natives *Hordeum jubatum* subspecies and *Munroa squarrosa*.

A few species were only found planted and persisting at old homesteads and other such sites. These are *Caragana arborescens*, *Cotoneaster lucidus*, *Lonicera tatarica*, *Malus pumila*, *Ulmus americana*, and *U. pumila*. *Syringa vulgaris* L. was also present but never collected at such sites. Many of the "historical" taxa added to the checklist were collected in disturbed areas including farm fields, gardens, and lawns. Over 35 percent of the historical taxa added to the checklist are exotic to Montana while about 14 percent of the taxa we collected are exotic (Mincemoyer 2012).

Taxa of Conservation Concern

Fifteen taxa of conservation concern were documented from 34 sites. These taxa are tracked by the Montana

Natural Heritage Program with state ranks of S1, S2, or S3 or are listed as sensitive by the Bureau of Land Management (MTNHP 2012b). These taxa are indicated by a diamond (♦) in the annotated checklist and listed alphabetically below.

Ammannia robusta (Lythraceae) was found in Valley County in a reservoir and adjacent mudflat. Voucher: *Nelson 81384.*

Anagallis minima (Myrsinaceae) was found in Phillips and Valley counties in vernal pools. Vouchers: *Charboneau 2486, 7921.*

Bacopa rotundifolia (Plantaginaceae) was found in Phillips County on the edge of a reservoir. Voucher: *Charboneau 9535.*

Botrychium hesperium (Ophioglossaceae) was found in Phillips County in a rocky disturbed area in lodgepole pine forest. Voucher: *Charboneau 2120.*

Carex scoparia var. **scoparia** (Cyperaceae) was found in Phillips County in a juniper thicket in the Missouri River Breaks and in a montane meadow. Vouchers: *Charboneau 2298, 7690.*

Elodea bifoliata (Hydrocharitaceae) was found in Phillips County floating in reservoirs. Vouchers: *Charboneau 9431, 9516, 9541.*

Phlox andicola (Polemoniaceae) was found in Phillips County in sagebrush steppe. Voucher: *Charboneau 5069.*

Physaria brassicoides (Brassicaceae) was found in Phillips County in a montane meadow. Voucher: *Charboneau 4812.*

Physaria ludoviciana (Brassicaceae) was found in Valley County in mixedgrass prairie. Vouchers: *Charboneau 4862; Nelson 82012.*

Plagiobothrys leptocladus (Boraginaceae) was found in Phillips and Valley counties in vernal areas. Vouchers: *Charboneau 1373b, 5791, 6144, 6870, 7209; Nelson 80119, 80180, 80542, 81590.*

Psilocarphus brevissimus var. **brevissimus** (Asteraceae) was found in Phillips County in a vernal area. Voucher: *Charboneau 7286a.*

Ranunculus hyperboreus (Ranunculaceae) was found in Valley County floating in a creek. Voucher: *Charboneau 2462.*

Senecio eremophilus var. **eremophilus** (Asteraceae) was found in Phillips County in montane disturbed areas. Vouchers: *Charboneau 2141, 9167; Nelson 81011.*

Sphenopholis intermedia (Poaceae) was found in Phillips County in mixed conifer forest. Voucher: *Charboneau 2199.*

Suckleya suckleyana (Amaranthaceae) was found in Valley County in dried reservoir bottoms and shores. Vouchers: *Charboneau 2736, 3354, 3843, 3860; Nelson 81378.*

Five additional taxa of conservation concern are known from the area though "historical" records: *Mentzelia nuda* (Loasaceae), *Penstemon grandiflorus* (Plantaginaceae), *Phacelia thermalis* (Boraginaceae), *Potentilla plattensis* (Rosaceae), and *Schoenoplectus heterochaetus* (Cyperaceae).

Exotic Taxa and Noxious Weeds

We collected 108 taxa exotic to Montana (Mincemoyer 2012), comprising 14.2 percent of the 762 taxa we collected. These taxa are indicated in the annotated checklist by an asterisk (*). Nine species (10 taxa) of the 32 species recognized as noxious weeds in Montana (MNWP 2010) were documented. These were *Acroptilon repens*, *Centaurea diffusa*, *C. stoebe*, *Cirsium arvense*, *Convolvulus arvensis*, *Cynoglossum officinale*, *Euphorbia esula* varieties, *Leucanthemum vulgare*, and *Tamarix chinensis*. In the annotated checklist these taxa are indicated by a circle (●). The most widespread and common of these noxious weeds are *Euphorbia esula* varieties and *Cirsium arvense*. Two Montana regulated plants (priority three weeds; MNWP 2010) were also found: *Bromus tectorum* and *Elaeagnus angustifolia*. Twenty-five of the 70 "historical" taxa added to the checklist (35.7 percent) are exotic to Montana (Mincemoyer 2012). Among these additional taxa are two Montana noxious weeds (MNWP

2010): *Lepidium latifolium* and *Tanacetum vulgare*. With the addition of the "historical" taxa, 16.0 percent of the taxa included in the annotated checklist are exotic (Mincemoyer 2012).

Newly Documented Taxa

The area's vascular flora was previously poorly documented. We collected 227 taxa and 201 species that had previously been undocumented (GPFA 1977; Hartman et al. 2009; Lesica 2012; USDA 2012; Kartesz 2013; MONT 2013; MONTU 2013). This accounts for 29.8 percent of the 762 taxa we collected. Only 8.8 percent of these 227 taxa are exotic to Montana (Mincemoyer 2012) indicating that these newly documented taxa predominantly are not newly introduced to the area. Of the 12,768 specimens we collected, 446 or more than one in every 29 collections are county records in either Phillips County or Valley County. On average we collected over four county records per person-day in the field.

Sampling Adequacy

GIS analyses.—In our assessment of the sampling adequacy of environmental conditions by our collection sites, we found that our sites did nearly as well as a set of random points. There were 66 combinations of elevation, average annual precipitation, and average daily minimum temperature classes within the lands accessible for collecting. Our actual collection sites were located in 42 of these combinations while a random set of the same number of points was located in 44 combinations. Our collection sites missed combinations comprising 2.2 percent of accessible lands, while the random points missed combinations totaling 1.1 percent.

While our collection sites sampled nearly as well as random points in environmental conditions, our collection sites outperformed random points in sampling land cover types. Thirty-nine land cover types are reported within accessible lands (MTNHP 2010). These are the same types described in the Montana Ecological Systems Field Guide (MTNHP 2012a). Our collection sites sampled 25 cover types, while the set of random points was only in 15. Our collection sites missed cover types totaling 1.1 percent of accessible lands, while random sites missed cover types making up 2.3 percent.

In both analyses, the frequency of collection sites and random points for the most part mirrored the frequency of environmental class combinations and land cover types of accessible lands, with important exceptions. Our actual sites oversampled rare combinations and cover classes such as those found in the Little Rocky Mountains while undersampling the most common combinations and classes. This allowed us to better document all of the taxa found in rare habitats. Random points also have the disadvantage of often being further from a road or trail than our actual collection sites.

Taxon accumulation curves.—Figure 3 shows the taxon accumulation curve with collecting days added in chronological order. The number of taxa collected levels off in the second year of the inventory as few new taxa were encountered in May and June 2011, although almost 100 were encountered for the first time in July and August 2011. In total 630 taxa (almost 83 percent) were encountered during the first field season, and an additional 132 were collected for the first time during the second field season.

Figure 4 shows the taxon accumulation curve averaged from 100 randomizations of the order of collecting days. The curve levels off fairly well with 90 percent of observed taxon richness encountered by about 60 of 102 collecting days. The asymptote of the species accumulation curve as predicted by the Michaelis-Menten equation (see Colwell and Coddington 1994) reaches 797 taxa, only 35 more than we observed. Parametric estimators gave higher estimates of diversity: the bootstrap estimator predicted 829 taxa, the Chao 1 estimator 885 taxa, and the second-order jackknife estimator 965 taxa. The addition of 70 "historical" taxa to the checklist brings the total number of known taxa to 832, greater than predicted by the Michaelis-Menten equation and the bootstrap estimator based on our collections. Many of the "historical" taxa added were collected in habitats that we did not focus our efforts on such as lawns, gardens, and cultivated fields, which may explain this discrepancy. Based on the addition of these "historical" taxa and our estimates of the taxon diversity present in the area, we collected between 79 and 91.6 percent of the taxa growing in the area.

Our estimate of the actual diversity documented and our analyses of the environmental conditions and

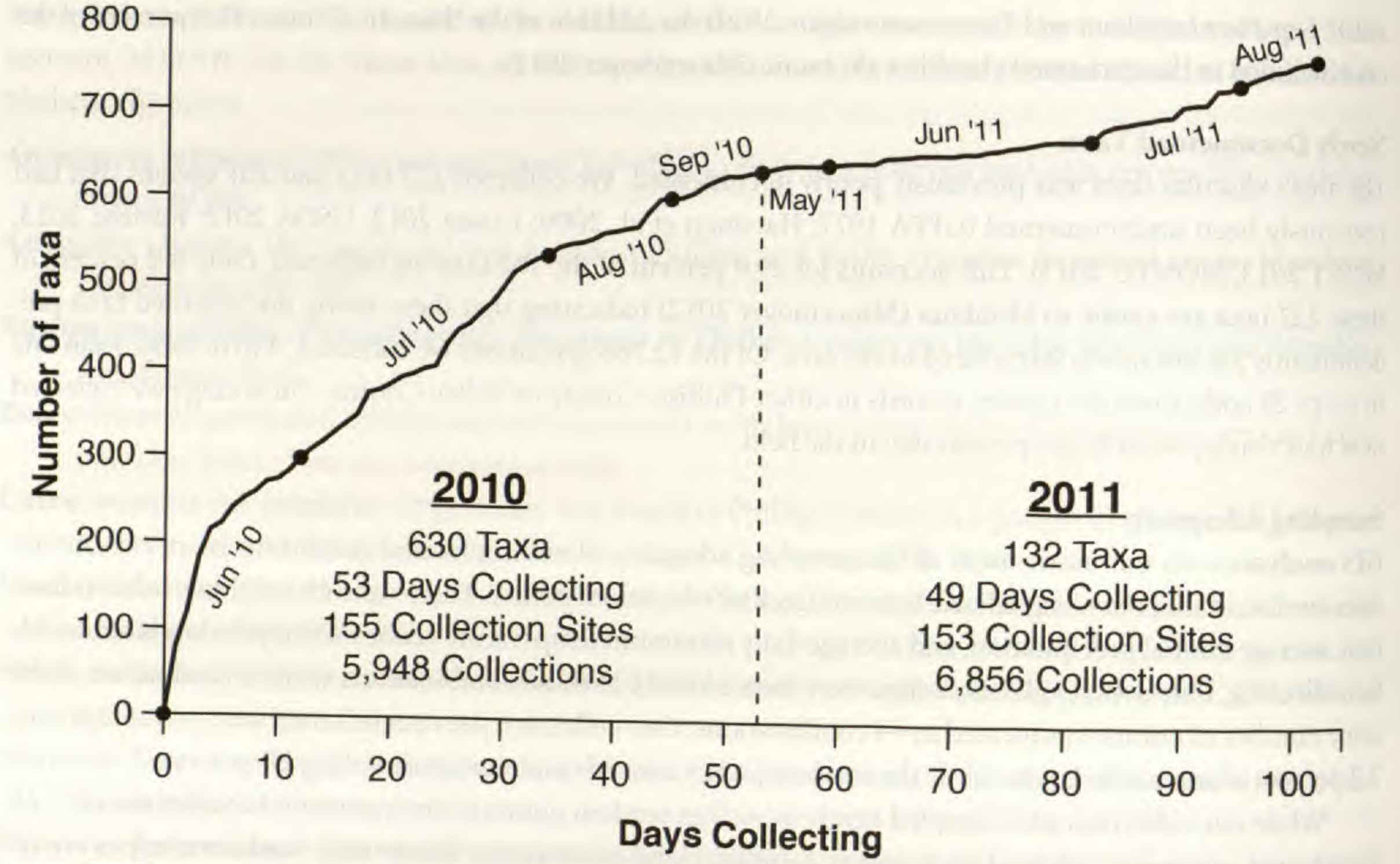

FIG. 3. Taxa accumulated by days collecting in chronological order. In total 762 taxa were collected: 630 during 2010 and an additional 132 for the first time in 2011. Data generated using EstimateS (Colwell 2013).

land cover types sampled by collection sites show we performed adequately in documenting the diversity of vascular plants. Because of the number of taxa documented for the first time in July and August of the second field season and the relatively short time spent collecting in September, the late summer and early fall likely would be the most worthwhile part of the growing season for further collecting.

CONCLUSIONS

This inventory has greatly expanded the floristic knowledge of a 23,191 sq km (8,954 sq mi) area of northeastern Montana. Approximately one in every 29 collections made (446 of 12,768) were county records in either Phillips County or Valley County, and about 30 percent of the taxa we documented were previously unknown from the area. In total, we collected 762 vascular plant taxa from 86 families, an estimated 79–92 percent of the actual vascular plant diversity present in the area. The addition of 70 "historical" taxa brings the total number of unique taxa from the area to 832. This study demonstrates there is still much to be learned about the flora of many parts of the contiguous United States.

ANNOTATED CHECKLIST

The checklist is organized by major groups of vascular plants (fern allies, ferns, gymnosperms, and angiosperms), then alphabetically by family and species. Nomenclature follows that of the RM Plant Specimen Database (Hartman et al. 2009). The reader is referred to the synonymized checklist in USDA (2012) if there is a ny confusion. Collection data are available online at http://www.rmh.uwyo.edu. Below is a key to the abbreviations and symbols used with individual taxa. The format of each listing is as follows: *Taxon* Authority **(number of collections)** COUNTY; elevation; Vegetation type. Listings of "historical" taxa collected by other workers use the following format: *Taxon* Authority; *Collector's name and number* (HERBARIUM); COUNTY.

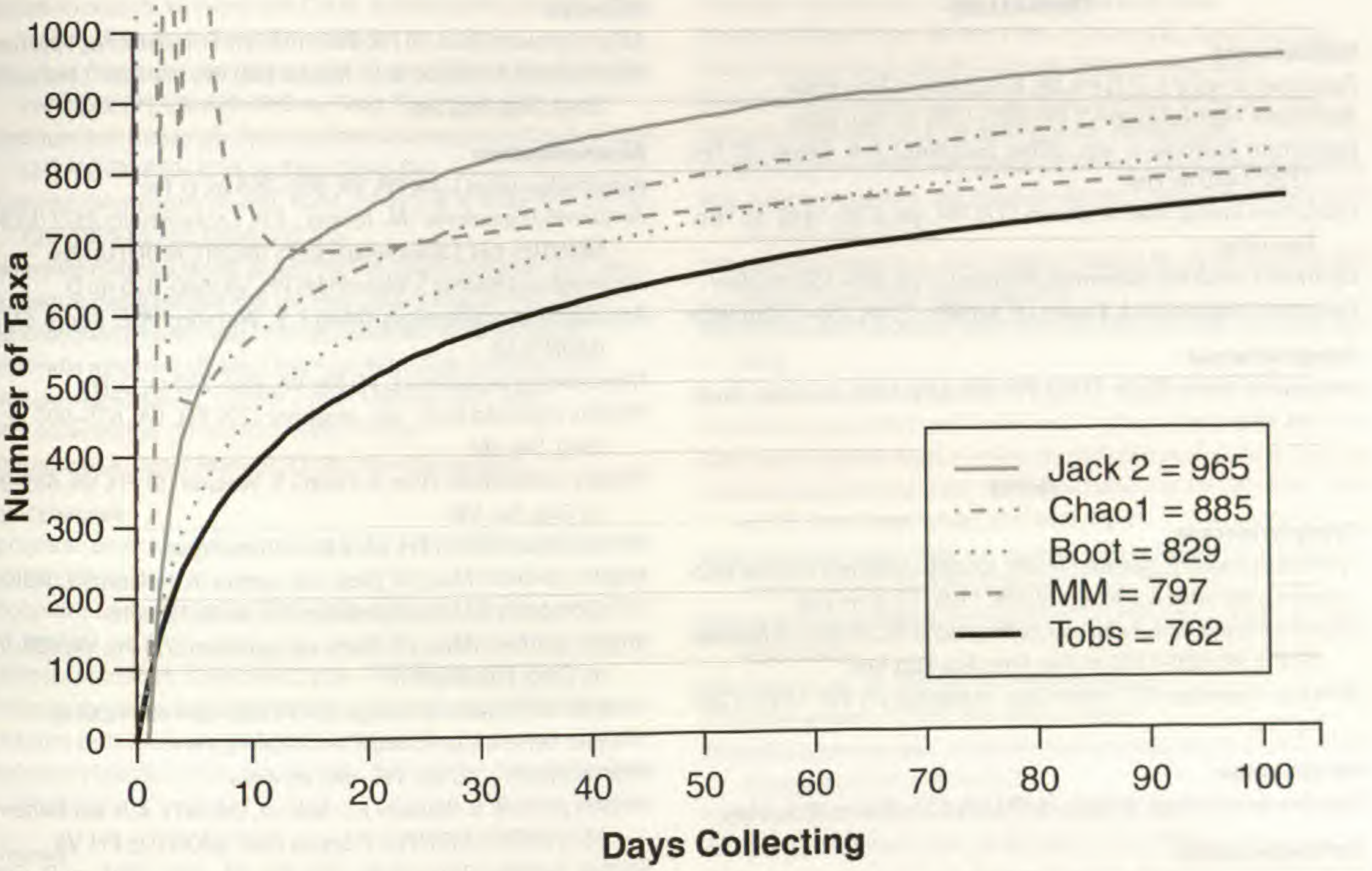

Fig. 4. Average taxa accumulated from 50 randomizations of collecting day order with estimators of taxon diversity. The number of taxa estimated or observed follow these abbreviations: Jack2 = 2nd order jackknife estimator, Chao1 = Chao 1 estimator, Boot = bootstrap estimator, MM = Michaelis-Menten estimator, Tobs = taxa observed. Data generated using EstimateS (Colwell 2013).

County abbreviations:

PH Phillips

VA Valley

Habitat Types:

D Disturbed
Flp Lodgepole pine forest
Fmc Montane mixed conifer forest
Fmr Montane riparian forest
Fpj Ponderosa pine-juniper woodland
Fpp Montane ponderosa pine forest
Frc Riparian cottonwood forest
Ftw Thicket and wooded coulee
Gmg Mixedgrass prairie
Gmm Montane meadow
Gup Upland prairie
Sgs Greasewood shrubland
Sjw Juniper steppe/woodland
Sss Sagebrush steppe
Vbl Badlands
Vot Rock outcrops and talus
Wal Alkaline wetland
Wcb Moist coulee bottom and swale
Wpw Persistent wetland

Symbols preceding taxa:

* Taxon exotic to Montana
● Montana noxious weed
♦ Taxon of conservation concern
× Putative hybrid

FERN ALLIES

Equisetaceae

Equisetum arvense L. (13) PH, VA; 670–1395 m; Fmr, Wpw
Equisetum ×ferrissii Clute (3) PH; 685–1395 m; Fmr, Wpw
Equisetum hyemale L. var. *affine* (Engelm.) A.A. Eaton (5) PH; 1220–1440 m; Fmr
Equisetum laevigatum A. Braun (12) PH, VA; 670–1440 m; Fpp, Ftw, Gmg
Equisetum ×mackaii (Newman) Brichan (1) VA; 680–750 m; Wpw
Equisetum ×nelsonii (A.A. Eaton) J.H. Schaffn. (1) VA; 750–770 m; Wcb

Selaginellaceae

Selaginella densa Rydb. (118) PH, VA; 635–1645 m; Gmg, Gup, Sss, Wcb

FERNS

Dryopteridaceae

Cystopteris fragilis (L.) Bernh. (14) PH, VA; 680–1645 m; Fmr, Ftw, Wcb
Dryopteris filix-mas (L.) Schott (2) PH; 1195–1350 m; Fmr
Woodsia oregana D.C. Eaton var. *cathcartiana* (B.L. Rob.) C.V. Morton (9) PH, VA; 620–1735 m; Flp, Fmc, Fpj, Fpp, Vot
Woodsia scopulina D.C. Eaton ssp. *scopulina* (1) PH; 1195–1230 m; Fmc

Marsileaceae

Marsilea vestita Hook. & Grev. (4) PH, VA; 650–830 m; Wcb, Wpw

Ophioglossaceae

♦ *Botrychium hesperium* (Maxon & R.T. Clausen) W.H. Wagner & Lellinger (1) PH; 1620–1675 m; Flp

Pteridaceae

Cheilanthes feei T. Moore (7) PH; 1195–1440 m; Vot
Pellaea glabella Mett. ex Kuhn var. *occidentalis* (E.E. Nelson) Butters; *P. Lesica 3159* (MONTU); PH

GYMNOSPERMS

Cupressaceae

Juniperus communis L. var. *depressa* Pursh (52) PH, VA; 675–1740 m; Flp, Fmc, Fmr, Fpj, Fpp, Ftw
Juniperus ×fassettii B. Boivin (23) PH, VA; 620–1645 m; Fpj, Ftw, Sjw, Sss
Juniperus horizontalis Moench (90) PH, VA; 655–1685 m; Ftw, Gmg, Gup, Sjw, Sss, Wcb
Juniperus scopulorum Sarg. (63) PH, VA; 620–1485 m; Fpj, Fpp, Ftw, Gup, Sjw, Sss, Wcb

Pinaceae

Pinus contorta Douglas ex Loudon var. *latifolia* Engelm. (16) PH; 1245–1740 m; Flp, Fmc, Fmr
Pinus ponderosa C. Lawson & P. Lawson var. *scopulorum* Engelm. (44) PH, VA; 620–1735 m; Fmc, Fmr, Fpj, Fpp
Pseudotsuga menziesii (Mirb.) Franco var. *glauca* (Beissn.) Franco (35) PH; 830–1740 m; Fmc, Fmr, Fpj

ANGIOSPERMS

Adoxaceae

Viburnum edule (Michx.) Raf.; *C. Doll s.n.* (MONT); PH

Alismataceae

Alisma gramineum Lej. (5) PH, VA; 740–810 m; Wpw
Alisma triviale Pursh (17) PH, VA; 635–935 m; Wpw
Sagittaria cuneata E. Sheld. (21) PH, VA; 635–935 m; Wpw
Sagittaria montevidensis Cham. & Schltdl. ssp. *calycina* (Engelm.) Bogin; *K.H. Lackschewitz 8613* (MONT); PH

Alliaceae

Allium cernuum Roth (9) PH; 895–1735 m; Fmc, Fmr, Fpj, Fpp, Gmm
Allium textile A. Nelson & J.F Macbr. (86) PH, VA; 620–1440 m; Fpj, Gmg, Gup, Sgs, Sss

Amaranthaceae

Amaranthus albus L. (4) PH, VA; 650–895 m; D, Frc
Amaranthus arenicola I.M. Johnst.; *K.H. Lackschewitz 8372* (MONT, MONTU), *K.H. Lackschewitz 8595* (MONT, MONTU); PH
Amaranthus blitoides S. Watson (4) PH, VA; 680–825 m; D
Amaranthus californicus (Moq.) S. Watson; *W.E. Booth 61722* (MONT); VA
**Amaranthus retroflexus* L. (4) PH, VA; 650–780 m; D, Frc
Atriplex argentea Nutt. var. *argentea* (22) PH, VA; 675–905 m; D, Gmg, Sss, Vbl
Atriplex confertifolia (Torr. & Frém.) S. Watson (5) PH, VA; 685–945 m; Gup, Sss, Vbl
Atriplex dioica Raf. (3) PH, VA; 650–670 m; Wpw
Atriplex gardneri (Moq.) D. Dietr. var. *aptera* (A. Nelson) S.L. Welsh & Crompton; *K.H. Lackschewitz 8597* (MONTU); PH
Atriplex gardneri (Moq.) D. Dietr. var. *gardneri* (72) PH, VA; 650–970 m; Gmg, Sgs, Sss, Vbl
**Atriplex heterosperma* Bunge (5) PH; 660–690 m; Frc, Gmg
**Atriplex hortensis* L.; *R. Feigel s.n.* (MONT); PH
Atriplex patula L. (2) VA; 740–845 m; Wpw
Atriplex powellii S. Watson; *E.J. Bell s.n.* (MONT), *K.H. Lackschewitz 8633* (MONT, MONTU), *P. Lesica 4597* (MONTU); PH, VA
Atriplex suckleyi (Torr.) Rydb. (66) PH, VA; 660–1005 m; D, Gmg, Sgs, Sss, Vbl
**Bassia hyssopifolia* (Pall.) Kuntze (1) VA; 790–810 m; Sss
Chenopodium berlandieri Moq. var. *zschackei* (Murr) Murr ex Asch. (29) PH, VA; 650–1340 m; D, Fpj, Frc, Ftw, Gup, Sgs, Wcb
Chenopodium desiccatum A. Nelson (6) PH, VA; 715–895 m; D, Gmg
Chenopodium fremontii S. Watson (6) PH, VA; 675–935 m; Fpj, Frc, Ftw, Sjw
Chenopodium glaucum L. var. *salinum* (Standl.) B. Boivin (7) PH, VA; 650–865 m; Frc, Wcb, Wpw
Chenopodium pratericola Rydb. (21) PH, VA; 635–975 m; D, Gmg, Gup, Sss, Wpw
Chenopodium rubrum L. var. *rubrum* (1) PH; 660 m; Frc
**Halogeton glomeratus* (M. Bieb.) C.A. Mey. (1) PH; 855–900 m; Wcb
**Kochia scoparia* (L.) Schrad. (25) PH, VA; 650–905 m; D, Frc, Wcb
Krascheninnikovia lanata (Pursh) A. Meeuse & A. Smit (39) PH, VA; 670–990 m; Gmg, Gup, Sss
Monolepis nuttalliana (Schult.) Greene (80) PH, VA; 620–990 m; D, Gmg, Sgs, Sss, Vbl, Wcb
Salicornia rubra A. Nelson (4) PH; 675–935 m; Sgs, Wal
**Salsola tragus* L. (14) PH, VA; 650–855 m; D, Gmg
Suaeda calceoliformis (Hook.) Moq. (19) PH, VA; 650–935 m; D, Sgs, Sss, Vbl, Wal
Suaeda nigra (Raf.) J.F. Macbr. (6) PH, VA; 710–915 m; Sgs, Sss, Vbl
♦ *Suckleya suckleyana* (Torr.) Rydb. (5) VA; 670–800 m; D, Wpw

Anacardiaceae

Rhus trilobata Nutt. var. *trilobata* (93) PH, VA; 620–1440 m; Fpj, Ftw, Gmg, Gup, Sjw, Wcb
Toxicodendron rydbergii (Small ex Rydb.) Greene (12) PH, VA; 690–1320 m; Ftw, Wcb

Apiaceae

Cicuta maculata L. var. *angustifolia* Hook. (4) PH, VA; 800–930 m; Wpw
Cymopterus acaulis (Pursh) Raf. (14) PH, VA; 655–915 m; Gmg, Gup, Sss
Heracleum maximum Bartr. (7) PH, VA; 950–1470 m; Fmr

Lomatium cous (S. Watson) J.M. Coult. & Rose (6) PH, VA; 855–1645 m; Fmc, Fmr, Fpp, Gmg, Gmm, Wcb
Lomatium foeniculaceum (Nutt.) J.M. Coult. & Rose var. *foeniculaceum* (58) PH, VA; 620–990 m; Gmg, Gup, Sgs, Sss
Lomatium macrocarpum (Nutt. ex Torr. & A. Gray) J.M. Coult. & Rose (21) PH, VA; 670–1735 m; Fpp, Gmg, Sss
Musineon divaricatum (Pursh) Nutt. ex Torr. & A. Gray (62) PH, VA; 620–1005 m; Fpj, Gmg, Sgs, Sss
Osmorhiza chilensis Hook. & Arn. (6) PH; 1220–1735 m; Fmc, Fmr
Osmorhiza depauperata Phil. (6) PH; 1255–1735 m; Fmc, Fmr
Osmorhiza longistylis (Torr.) DC.; *P. Lesica 8074* (MONTU); PH
Perideridia montana (Blank.) Dorn (1) PH; 1320–1450 m; Fmc
Sanicula marilandica L. (9) PH; 1195–1685 m; Fmc, Fmr
Sium suave Walter (2) VA; 830–895 m; Wpw
Zizia aptera (A. Gray) Fernald (1) VA; 925–960 m; Wcb

Apocynaceae

Apocynum androsaemifolium L. (9) PH; 1220–1675 m; D, Fmc, Fmr, Fpp, Gmm
Apocynum cannabinum L. (5) PH, VA; 670–835 m; Gmg, Sgs, Wcb, Wpw
Asclepias pumila (A. Gray) Vail (2) VA; 785–890 m; Fpj, Sss
Asclepias speciosa Torr. (14) PH, VA; 675–1145 m; D, Wcb, Wpw
Asclepias verticillata L. (1) PH; 915–970 m; Gmg
Asclepias viridiflora Raf. (5) PH, VA; 745–945 m; Fpj, Ftw, Gmg, Gup, Sss

Araceae

Lemna turionifera Landolt (3) PH, VA; 675–835 m; Wpw

Asparagaceae

**Asparagus officinalis* L. (1) PH; 670 m; Wpw
Maianthemum racemosum (L.) Link var. *amplexicaule* (Nutt.) Dorn (19) PH; 1195–1735 m; Fmc, Fmr
Maianthemum stellatum (L.) Link (21) PH, VA; 685–1685 m; Fmc, Fmr, Fpp, Ftw, Wcb
Yucca glauca Nutt. (12) PH, VA; 675–1145 m; Gup

Asteraceae

Achillea millefolium L. (154) PH, VA; 620–1740 m; D, Fmc, Fmr, Fpj, Gmg, Sjw, Sss, Wcb
**● Acroptilon repens* (L.) DC. (1) PH; 690 m; Frc
Agoseris glauca (Pursh) Raf. var. *dasycephala* (Torr. & A. Gray) Jeps. (13) PH, VA; 730–990 m; Gmm, Sss, Wcb
Agoseris glauca (Pursh) Raf. var. *glauca* (18) PH, VA; 745–1575 m; Ftw, Gmg, Gmm, Sss, Wcb
Agoseris parviflora (Nutt.) D. Dietrich (4) PH, VA; 620–885 m; Fpj, Gmg, Gup, Sss
Almutaster pauciflorus (Nutt.) Á. Löve & D. Löve (1) VA; 845 m; Wpw
Ambrosia artemisiifolia L. (7) PH, VA; 650–845 m; D, Ftw, Wcb, Wpw
Ambrosia tomentosa Nutt.; *L.E. Thayer s.n.* (MONT); PH
Ambrosia trifida L. (5) PH, VA; 675–835 m; Frc, Sgs, Wpw
Anaphalis margaritacea (L.) Benth. & Hook. (3) PH; 1270–1395 m; Fmr
Antennaria dimorpha (Nutt.) Torr. & A. Gray; *A. Taylor 8561* (MONT); PH
Antennaria howellii Greene ssp. *howellii* (3) PH; 1295–1440 m; Flp, Fmc, Gmm
Antennaria howellii Greene ssp. *petaloidea* (Fernald) R.J. Bayer (15) PH, VA; 620–1735 m; Flp, Fmc, Fmr, Fpj, Fpp, Ftw, Gmg, Gmm, Sss
Antennaria microphylla Rydb. (33) PH, VA; 675–1145 m; Gmg, Sss, Wcb
Antennaria parvifolia Nutt. (97) PH, VA; 620–1675 m; Fpj, Gmg, Gmm, Gup, Sss, Wcb
Antennaria racemosa Hook. (3) PH; 1355–1735 m; Flp, Fmc, Fmr
Antennaria rosea Greene (31) PH, VA; 620–1495 m; Fpj, Ftw, Gmg, Wcb
**Arctium minus* Bernh. (2) PH; 1220–1245 m; D, Fmr
Arnica cordifolia Hook. (6) PH; 1195–1575 m; Flp, Fmc, Fmr, Fpp
Arnica fulgens Pursh (29) PH, VA; 660–990 m; Gmg, Wcb
Arnica sororia Greene (30) PH, VA; 620–1145 m; Gmg, Sss, Wcb
**Artemisia absinthium* L.; *D. Reinhard s.n.* (MONT); VA
Artemisia biennis Willd. var. *biennis* (6) PH, VA; 650–870 m; Wcb, Wpw
Artemisia campestris L. var. *caudata* (Michx.) Palmer & Steyerm. (1) VA; 830–890 m; Fpj
Artemisia campestris L. var. *pacifica* (Nutt.) M. Peck (32) PH, VA; 650–1740 m; Fpp, Gmg, Gup, Sss
Artemisia cana Pursh var. *cana* (38) PH, VA; 650–930 m; Gmg, Sss, Wcb
Artemisia dracunculus L. (15) PH, VA; 650–1225 m; D, Frc, Ftw, Gmg
Artemisia frigida Willd. (66) PH, VA; 650–1225 m; Gmg, Gup, Sss, Wcb
Artemisia longifolia Nutt. (17) PH, VA; 675–975 m; Fpj, Gmg, Sgs, Sss
Artemisia ludoviciana Nutt. var. *ludoviciana* (68) PH, VA; 650–1490 m; Frc, Ftw, Gmg, Gmm, Sss, Wcb, Wpw
Artemisia tridentata Nutt. var. *wyomingensis* (Beetle & Young) S.L. Welsh (14) PH, VA; 670–905 m; Fpj, Sgs, Sjw, Sss
Balsamorhiza sagittata (Pursh) Nutt. (7) PH; 1195–1685 m; Fmc, Fpp, Gmm
Bidens cernua L. (2) PH, VA; 650–690 m; Wpw
Bidens tripartita L. (2) PH; 660–690 m; Wpw
Brickellia eupatorioides (L.) Shinners var. *corymbulosa* (Torr. & A. Gray) Shinners (1) PH; 670 m; Gup
**Carduus acanthoides* L. (1) PH; 685–690 m; Wpw
**● Centaurea diffusa* Lam. (1) VA; 685–730 m; Wcb
**● Centaurea stoebe* L. ssp. *micranthos* (S.G. Gmel. ex Gugler) Hayek (7) PH, VA; 830–1615 m; D, Gmm, Wcb
Chaenactis douglasii (Hook.) Hook. & Arn. var. *douglasii* (18) PH, VA; 665–935 m; Fpj, Gmg, Gup, Sss, Vbl
**● Cirsium arvense* (L.) Scop. (34) PH, VA; 675–1740 m; D, Fmr, Ftw, Wcb, Wpw
Cirsium canescens Nutt. (5) PH, VA; 760–1050 m; Fpj, Gmg, Wcb
Cirsium flodmanii (Rydb.) Arthur (15) PH, VA; 740–1450 m; Fpp, Wcb, Wpw
Cirsium hookerianum Nutt. (1) PH; 940–975 m; Gup
Cirsium undulatum (Nutt.) Spreng. (28) PH, VA; 670–1490 m; D, Fpj, Fpp, Gmg, Sss, Wcb
**Cirsium vulgare* (Savi) Ten. (9) PH, VA; 685–1340 m; Fmr, Wcb
Conyza canadensis (L.) Cronquist (44) PH, VA; 650–975 m; D, Gmg, Sss, Wcb, Wpw
Coreopsis tinctoria Nutt. (9) PH, VA; 650–855 m; D, Wpw
Crepis atribarba A. Heller (3) PH, VA; 690–1395 m; Fpp, Gup
Crepis modocensis Greene var. *modocensis* (8) PH, VA; 710–885 m; Gmg, Gup, Sss
Crepis occidentalis Nutt. var. *costata* A. Gray (25) PH, VA; 620–1145 m; Fpj, Gmg, Sss
Crepis runcinata (E. James) Torr. & A. Gray var. *runcinata* (2) PH, VA; 850–960 m; Wal, Wcb
**Crepis tectorum* L. (10) VA; 660–990 m; D, Gmg, Sss, Wcb
Cyclachaena xanthifolia (Nutt.) Fresen. (6) PH, VA; 650–1225 m; D, Frc
Dieteria canescens (Pursh) Nutt. var. *canescens* (52) PH, VA; 640–990 m; D, Gmg, Sgs, Sss
Dyssodia papposa (Vent.) Hitchc. (1) PH; 770–780 m; Sjw
Echinacea angustifolia DC. (2) PH, VA; 685–945 m; Ftw, Gup
Ericameria nauseosa (Pall. ex Pursh) G.L. Nesom & G.I. Baird var. *graveolens* (Nutt.) Reveal & Schuyler (7) PH, VA; 685–1485 m; Frc, Gup, Sjw, Wcb
Ericameria nauseosa (Pall. ex Pursh) G.L. Nesom & G.I. Baird var. *nauseosa* (18) PH, VA; 670–895 m; Gmg, Gup, Sgs, Sss
Erigeron caespitosus Nutt. (30) PH, VA; 680–1735 m; Fpj, Fpp, Gmg, Gmm, Gup, Sss, Vot
Erigeron compositus Pursh (13) PH, VA; 670–1440 m; Gmg, Gup, Vot

Erigeron corymbosus Nutt. (2) PH, VA; 830–1450 m; Fpp, Wcb
Erigeron glabellus Nutt. var. *glabellus* (13) PH, VA; 690–990 m; Ftw, Wcb
Erigeron glabellus Nutt. var. *pubescens* Hook. (2) PH, VA; 730–845 m; Gmg, Wcb
Erigeron ochroleucus Nutt.; *A. Taylor 8590* (MONT); PH
Erigeron pumilus Nutt. var. *pumilus* (91) PH, VA; 620–1145 m; Fpj, Gmg, Gmm, Sss
Erigeron speciosus (Lindl.) DC. (3) PH; 1195–1470 m; Fmr, Fpp
Erigeron strigosus Muhl. ex Willd. var. *septentrionalis* (Fernald & Wiegand) Fernald (1) PH; 1480–1685 m; Fmc
Erigeron strigosus Muhl. ex Willd. var. *strigosus* (1) PH; 885–945 m; Gmg
Eurybia conspicua (Lindl.) G.L. Nesom (3) PH; 1195–1485 m; Fmc, Fmr
Gaillardia aristata Pursh (51) PH, VA; 675–1735 m; Fmc, Fpp, Gmg, Gup, Sss, Wcb
Gnaphalium palustre Nutt. (7) PH, VA; 690–915 m; Frc, Wcb
Grindelia squarrosa (Pursh) Dunal (82) PH, VA; 650–1485 m; D, Gmg, Sgs, Sss, Wcb
Gutierrezia sarothrae (Pursh) Britton & Rusby (53) PH, VA; 650–1365 m; Gmg, Sgs, Sss
Helenium autumnale L. (1) PH; 690 m; Wpw
Helianthus annuus L. (64) PH, VA; 635–1225 m; D, Gmg, Sgs, Sss
Helianthus maximiliani Schrad. (14) PH, VA; 685–945 m; Ftw, Wcb, Wpw
Helianthus nuttallii Torr. & A. Gray ssp. *nuttallii* (8) PH, VA; 650–890 m; Wcb, Wpw
Helianthus nuttallii Torr. & A. Gray ssp. *rydbergii* (Britton) R.W. Long (1) VA; 690 m; Wpw
Helianthus pauciflorus Nutt. var. *subrhomboideus* (Rydb.) Cronquist (7) PH; 1195–1490 m; Fmc, Fpp
Helianthus petiolaris Nutt. var. *petiolaris* (24) PH, VA; 660–955 m; D, Gmg, Gup, Sss
Heterotheca horrida (Rydb.) V.L. Harms; *J. Mundinger 172* (MONT); PH
Heterotheca villosa (Pursh) Shinners var. *villosa* (98) PH, VA; 635–1675 m; Gmg, Gup, Sss
Hieracium albiflorum Hook. (1) PH; 1275–1350 m; Flp
Hieracium scouleri Hook. (1) PH; 1360–1450 m; Fpp
Hieracium umbellatum L. (10) PH; 1195–1490 m; Flp, Fmc, Fmr, Fpp
Hymenopappus filifolius Hook. var. *polycephalus* (Osterh.) B.L. Turner (41) PH, VA; 675–1450 m; Gmg, Gup, Sss
Hymenoxys richardsonii (Hook.) Cockerell var. *richardsonii* (75) PH, VA; 620–1050 m; Fpj, Gmg, Gup, Sss
Iva axillaris Pursh (75) PH, VA; 620–1050 m; D, Fpj, Gmg, Sgs, Sss, Vbl, Wal
Lactuca ludoviciana (Nutt.) Riddell (3) PH; 1270–1395 m; Fmr
**Lactuca serriola* L. (44) PH, VA; 650–1490 m; D, Gmg, Sgs, Sss, Wcb, Wpw
*● *Leucanthemum vulgare* Lam. (1) PH; 1270–1395 m; Fmr
Liatris punctata Hook. var. *punctata* (30) PH, VA; 670–1485 m; Fpp, Gmg, Gmm, Sss, Wcb
**Logfia arvensis* (L.) Holub (53) PH, VA; 640–1735 m; Fpj, Gmg, Sss, Wcb
Lygodesmia juncea (Pursh) D. Don ex Hook. (10) PH, VA; 685–945 m; D, Gmg, Sss
Madia glomerata Hook. (4) PH, VA; 775–915 m; D, Ftw, Wcb, Wpw
**Matricaria discoidea* DC.; *M.G. Atwater s.n.* (MONT); PH
Microseris nutans (Hook.) Sch. Bip. (7) PH; 745–980 m; Fpj, Gmg, Sss
Mulgedium pulchellum (Pursh) G. Don (28) PH, VA; 675–945 m; D, Ftw, Gmg, Sjw, Wcb, Wpw
Nothocalais cuspidata (Pursh) Greene (26) PH, VA; 685–1005 m; Gmg, Sss, Wcb
Packera cana (Hook.) W.A. Weber & Á. Löve (74) PH, VA; 620–1735 m; Fpj, Gmg, Gup, Sjw, Sss
Packera paupercula (Michx.) Á. Löve & D. Löve (2) PH; 1270–1395 m; Fmr
Picradeniopsis oppositifolia (Nutt.) Rydb. ex Britton (9) PH, VA; 715–1050 m; D, Sss
♦ *Psilocarphus brevissimus* Nutt. var. *brevissimus* (1) PH; 790 m; Wpw
Pyrrocoma lanceolata (Hook.) Greene var. *lanceolata* (2) VA; 830–845 m; Wpw
Ratibida columnifera (Nutt.) Wooton & Standl. (89) PH, VA; 635–1230 m; Fpj, Gmg, Sss, Wcb
**Scorzonera laciniata* L.; *P. Lesica 8114* (MONTU); PH
♦ *Senecio eremophilus* Richardson var. *eremophilus* (3) PH; 1290–1740 m; D, Fmc
Senecio integerrimus Nutt. var. *exaltatus* (Nutt.) Cronquist (4) PH, VA; 790–865 m; Gmg, Wcb
Senecio integerrimus Nutt. var. *integerrimus* (17) PH, VA; 690–990 m; Gmg, Gup
Senecio integerrimus Nutt. var. *scribneri* (Rydb.) T.M. Barkley (19) PH, VA; 670–990 m; Gmg, Sgs, Sss
Solidago altissima L. var. *gilvocanescens* (Rydb.) Semple (5) PH, VA; 730–870 m; Wcb, Wpw
Solidago gigantea Aiton (19) PH, VA; 650–1490 m; Fmr, Frc, Ftw, Wcb, Wpw
Solidago lepida DC. var. *lepida* (4) PH, VA; 770–1340 m; Fmr, Gmg, Wcb
Solidago lepida DC. var. *salebrosa* (Piper) Semple (4) PH; 1240–1485 m; Flp, Fmr, Gmm
Solidago missouriensis Nutt. (58) PH, VA; 670–1575 m; D, Ftw, Gmg, Sss, Wcb
Solidago mollis Bartl. (13) PH, VA; 670–1365 m; Gmm, Gup, Wcb
Solidago nemoralis Aiton var. *longipetiolata* (Mack. & Bush) E.J. Palmer & Steyerm. (13) PH, VA; 755–1645 m; Flp, Fmc, Fpj, Fpp, Ftw, Gmm, Sss
Solidago rigida L. var. *humilis* Porter (19) PH, VA; 690–1450 m; Fpp, Ftw, Gmm, Wcb, Wpw
Solidago simplex Kunth var. *simplex* (5) PH; 1250–1740 m; D, Fpp
**Sonchus arvensis* L. ssp. *uliginosus* (M. Bieb.) Nyman (24) PH, VA; 660–1490 m; Frc, Wcb, Wpw
Stenotus acaulis (Nutt.) Nutt.; *F.B. Cotner s.n.* (MONTU); PH
Stenotus armerioides Nutt. var. *armerioides* (15) PH, VA; 700–1145 m; Fpj, Gmg, Gup
Stephanomeria runcinata Nutt. (19) PH, VA; 675–1450 m; Gmg, Gup, Sgs
Stephanomeria tenuifolia (Raf.) H.M. Hall (8) PH, VA; 680–1050 m; Fpj, Gmg
Symphyotrichum ascendens (Lindl.) G.L. Nesom (11) PH, VA; 680–930 m; Wcb, Wpw
Symphyotrichum ciliatum (Ledeb.) G.L. Nesom (3) PH, VA; 650–865 m; Wpw
Symphyotrichum ciliolatum (Lindl.) Á. Löve (9) PH; 1195–1490 m; Fmr, Gmm
Symphyotrichum eatonii (A. Gray) G.L. Nesom (3) PH; 1195–1340 m; Fmr
Symphyotrichum ericoides (L.) G.L. Nesom var. *pansum* (S.F. Blake) G.L. Nesom (10) PH, VA; 650–930 m; Wcb, Wpw
Symphyotrichum falcatum (Lindl.) G.L. Nesom var. *commutatum* (Torr. & A. Gray) G.L. Nesom (15) PH, VA; 650–1365 m; Gmg, Gmm, Sss, Wpw
Symphyotrichum falcatum (Lindl.) G.L. Nesom var. *falcatum* (24) PH, VA; 660–1485 m; D, Ftw, Gmg, Sss, Wcb, Wpw
Symphyotrichum laeve (L.) Á. Löve & D. Löve var. *geyeri* (A. Gray) G.L. Nesom (6) PH, VA; 650–1365 m; Fmr, Fpp, Frc, Ftw
Symphyotrichum lanceolatum (Willd.) G.L. Nesom var. *hesperium* (A. Gray) G.L. Nesom (7) PH, VA; 650–915 m; Frc, Wcb, Wpw
*● *Tanacetum vulgare* L.; *B. Crater s.n.* (MONT); VA

**Taraxacum erythrospermum* Andrz. ex Besser (50) PH, VA; 655–1440 m; D, Gmg, Sss
**Taraxacum officinale* Weber ex F.H. Wigg. (7) PH, VA; 670–1440 m; D, Gmg, Sss
Tetraneuris acaulis (Pursh) Greene var. *acaulis* (19) PH; 690–1450 m; Fmc, Fpj, Fpp, Gmg, Gup, Sss
Townsendia exscapa (Richardson) Porter (1) VA; 655–660 m; Gmg
Townsendia hookeri Beaman (5) PH, VA; 670–1440 m; Gmg, Gup, Vot
**Tragopogon dubius* Scop. (128) PH, VA; 620–1735 m; D, Fpj, Gmg, Gup, Sgs, Sjw, Sss, Wcb
Xanthisma grindelioides (Nutt.) D.R. Morgan & R.L. Hartm. var. *grindelioides* (25) PH, VA; 675–1145 m; Gmg, Gup, Sss
Xanthisma spinulosum (Pursh) D.R. Morgan & R.L. Hartm. var. *spinulosum* (19) PH, VA; 670–935 m; Gmg, Gup, Sss
Xanthium strumarium L. (51) PH, VA; 650–935 m; D, Frc, Wal, Wcb, Wpw

Berberidaceae

Berberis repens Lindl. (8) PH; 1195–1485 m; Flp, Fmc, Fmr, Fpp

Betulaceae

Betula occidentalis Hook. (1) VA; 680–750 m; Ftw
Betula papyrifera Marshall var. *papyrifera* (19) PH; 1195–1685 m; Fmc, Fmr

Boraginaceae

**Asperugo procumbens* L.; *D. Young s.n.* (MONT); PH
Cryptantha celosioides (Eastw.) Payson (14) PH, VA; 640–1050 m; Gup
Cryptantha minima Rydb. (3) VA; 640–675 m; Gmg
Cryptantha spiculifera (Piper) Payson (20) PH, VA; 675–1145 m; Gmg, Gup
Cryptantha torreyana (A. Gray) Greene (2) PH; 805–935 m; Fpj
**● Cynoglossum officinale* L. (6) PH; 760–1440 m; D, Gmm
Ellisia nyctelea (L.) L. (10) PH, VA; 685–885 m; D, Fpj, Sjw, Vbl
Hackelia deflexa (Wahlenb.) Opiz var. *americana* (A. Gray) Fernald & I.M. Johnst. (2) PH; 845–900 m; Ftw
Hackelia floribunda (Lehm.) I.M. Johnst. (4) PH, VA; 870–1340 m; Fmr, Ftw, Wcb
Heliotropium curassavicum L. var. *obovatum* DC. (2) PH; 675–730 m; Wal
Lappula cenchrusoides A. Nelson (23) PH, VA; 640–975 m; D, Gmg, Gup, Sgs, Sss
Lappula occidentalis (S. Watson) Greene var. *occidentalis* (52) PH, VA; 660–1225 m; D, Gmg, Gup, Sss, Wcb
**Lappula squarrosa* (Retz.) Dumort. (5) PH, VA; 830–1225 m; D, Gmg, Sss
Lithospermum incisum Lehm. (30) PH, VA; 670–1370 m; Gmg, Gup, Sjw, Sss
Lithospermum ruderale Douglas ex Lehm. (5) PH; 1195–1440 m; Fpp, Gmm
Mertensia lanceolata (Pursh) DC. (11) PH, VA; 670–925 m; Gmg, Wcb
Phacelia linearis (Pursh) Holz. (30) PH, VA; 620–1675 m; Fpj, Gmg, Sss
♦Phacelia thermalis Greene; *R. Feigel s.n.* (MONT), *K.H. Lackschewitz 8125* (MONT, MONTU); PH
♦ Plagiobothrys leptocladus (Greene) I.M. Johnst. (9) PH, VA; 745–885 m; Wcb, Wpw
Plagiobothrys scouleri (Hook. & Arn.) I.M. Johnst. var. *hispidulus* (Greene) Dorn (7) PH, VA; 740–930 m; Wcb, Wpw

Brassicaceae

**Alyssum alyssoides* (L.) L. (8) PH; 755–1575 m; D, Sss
**Alyssum desertorum* Stapf (49) PH, VA; 655–1005 m; D, Gmg, Sss
Arabis eschscholtziana Andrz. (1) PH; 1275 m; D
Arabis pycnocarpa M. Hopkins var. *pycnocarpa* (21) PH, VA; 620–1735 m; Gmm, Wcb
**Armoracia rusticana* P. Gaertn., B. Mey., & Schreb.; *K.H. Lackschewitz 8043* (MONT, MONTU), *R. Stellflug s.n.* (MONT); VA
Boechera collinsii (Fernald) Löve & D. Löve (63) PH, VA; 620–1735 m; Gmg, Sss
Boechera grahamii (Lehm.) Windham & Al-Shehbaz (20) PH, VA; 690–1365 m; Gmg
Boechera holboellii (Hornem.) Á. Löve & D. Löve var. *secunda* (Howell) Dorn (3) PH, VA; 700–1160 m; D, Sss
**Camelina microcarpa* Andrz. ex DC. (73) PH, VA; 635–1575 m; D, Ftw, Gmg, Sss, Wcb
**Capsella bursa-pastoris* (L.) Medik. (5) PH, VA; 725–1340 m; D
**Chorispora tenella* (Pall.) DC. (2) PH, VA; 655–710 m; D
**Conringia orientalis* (L.) Dumort. (23) PH, VA; 635–990 m; Gmg, Sgs, Sss, Vbl
Descurainia incana (Bernh. ex Fisch. & C.A. Mey.) Dorn (1) PH; 845–895 m; Ftw
Descurainia nelsonii (Rydb.) Al-Shehbaz & Goodson (1) PH; 675–685 m; Frc
Descurainia pinnata (Walter) Britton var. *brachycarpa* (Richardson) Fernald (56) PH, VA; 660–1340 m; Fpj, Gmg, Sss
**Descurainia sophia* (L.) Webb ex Prantl (56) PH, VA; 660–990 m; D, Ftw, Gmg
Draba cana Rydb. (3) PH; 1195–1735 m; Vot
**Draba nemorosa* L. var. *nemorosa* (32) PH, VA; 655–1440 m; Gmg, Wcb
Draba reptans (Lam.) Fernald (22) PH, VA; 620–1370 m; Gmg, Gup, Sss
Erysimum asperum (Nutt.) DC. (16) PH, VA; 640–860 m; Gmg, Gup, Sss
Erysimum capitatum (Douglas ex Hook.) Greene var. *purshii* (T. Durand) Rollins (5) VA; 660–955 m; Gmg, Gup, Sss
Erysimum cheiranthoides L. (5) PH, VA; 845–1275 m; D, Ftw
Erysimum inconspicuum (S. Watson) MacMill. (74) PH, VA; 620–1450 m; Fpj, Gmg, Gup, Sss, Wcb
**Hesperis matronalis* L. (2) PH, VA; 660–1470 m; D
**Lepidium campestre* (L.) R. Br. (1) PH; 1220–1340 m; D
Lepidium densiflorum Schrad. var. *densiflorum* (40) PH, VA; 640–1050 m; D, Gmg, Sss
Lepidium densiflorum Schrad. var. *macrocarpum* G.A. Mulligan (48) PH, VA; 620–990 m; D, Gmg, Sgs, Sss
**●Lepidium latifolium* L.; *D. Ueseth s.n.* (MONT); PH
**Lepidium perfoliatum* L. (13) PH, VA; 640–895 m; D, Gmg, Sgs, Sss
Lepidium ramosissimum A. Nelson var. *bourgeauanum* (Thell.) Rollins (2) VA; 700–905 m; Gmg
Lepidium ramosissimum A. Nelson var. *ramosissimum* (2) VA; 775–835 m; D
**Malcolmia africana* (L.) R. Br. (1) VA; 660 m; D
Physaria arenosa (Richardson) O'Kane & Al-Shehbaz var. *arenosa* (30) PH, VA; 655–1005 m; Gmg, Gup, Sjw, Sss
♦ Physaria brassicoides Rydb. (1) PH; 1245–1370 m; Fpp
♦ Physaria ludoviciana (Nutt.) O'Kane & Al-Shehbaz (2) PH, VA; 770–830 m; Gmg
Physaria spatulata (Rydb.) Grady & O'Kane (24) PH, VA; 675–1145 m; Fpj, Gmg, Gup, Sss
Rorippa curvipes Greene var. *curvipes* (1) PH; 775–780 m; Wpw
Rorippa sinuata (Nutt.) Hitchc.; *J.W. Blankinship s.n.* (MONT), *T. Fisher s.n.* (MONT), *K.H. Lackschewitz 8843* (MONTU), *P. Lesica 4596* (MONTU); PH, VA
Rorippa tenerrima Greene (1) VA; 830–835 m; Wpw
**Sinapis arvensis* L.; *W.E. Booth s.n.* (MONT); VA
**Sisymbrium altissimum* L. (30) PH, VA; 635–945 m; D, Gmg, Gup, Sss, Wcb
**Sisymbrium loeselii* L.; *F.B. Cotner s.n.* (MONT), *K.H. Lackschewitz 8379* (MONT); PH
**Thlaspi arvense* L. (70) PH, VA; 635–1575 m; D, Ftw, Gmg, Sss, Wcb, Wpw
**Turritis glabra* L. (9) PH, VA; 805–1645 m; D, Fmr, Ftw, Gmm

Cactaceae
Coryphantha missouriensis (Sweet) Britton & Rose var. *missouriensis* (1) PH; 705–730 m; Sss
Coryphantha vivipara (Nutt.) Britton & Rose (7) PH, VA; 790–925 m; Gmg, Sss
Opuntia fragilis (Nutt.) Haw. (7) PH, VA; 620–1145 m; Fpj, Gmg, Sss
Opuntia polyacantha Haw. var. *polyacantha* (63) PH, VA; 635–1145 m; Fpj, Gmg, Sgs, Sss

Campanulaceae
**Campanula rapunculoides* L. (1) PH; 1240–1320 m; Fmr
Campanula rotundifolia L. (44) PH, VA; 675–1740 m; Fmc, Fmr, Ftw, Gmg, Wcb
Triodanis leptocarpa (Nutt.) Nieuwl. (3) PH, VA; 720–830 m; Gmg, Sss

Caprifoliaceae
Linnaea borealis L. var. *longiflora* Torr. (13) PH; 1195–1735 m; Flp, Fmc, Fmr
**Lonicera tatarica* L. (1) VA; 830–835 m; D
Symphoricarpos albus (L.) S.F. Blake var. *albus* (2) PH; 760–1685 m; Fmc, Gmg
Symphoricarpos albus (L.) S.F. Blake var. *laevigatus* (Fernald) S.F. Blake (1) PH; 1275–1350 m; Flp
Symphoricarpos occidentalis Hook. (58) PH, VA; 635–1450 m; Fpj, Frc, Ftw, Wcb, Wpw
Symphoricarpos oreophilus A. Gray var. *utahensis* (Rydb.) A. Nelson (3) PH; 1160–1735 m; Fmc, Gmm

Caryophyllaceae
Cerastium arvense L. var. *strictum* (Gaudin) W.D.J. Koch (60) PH, VA; 685–1735 m; Fpp, Ftw, Gmg, Gmm, Sss, Wcb
Cerastium brachypodum (Engelm. ex A. Gray) B.L. Rob. (3) PH, VA; 830–890 m; Gmg, Wcb, Wpw
**Cerastium fontanum* Baumg. ssp. *vulgare* (Hartm.) Greuter & Burdet (1) PH; 1275–1350 m; Fmr
Eremogone congesta (Nutt.) Ikonn. var. *lithophila* (Rydb.) Dorn (11) PH; 775–1735 m; Gmg, Gmm, Sss, Wcb
Minuartia rubella (Wahlenb.) Hiern (3) PH; 1195–1735 m; Vot
Moehringia lateriflora (L.) Fenzl (8) PH; 1195–1470 m; Fmc, Fmr
Paronychia sessiliflora Nutt. (13) PH, VA; 675–1145 m; Gmg, Gup
**Silene csereii* Baumg. (6) PH, VA; 660–1340 m; D, Fmr
Silene drummondii Hook. var. *drummondii* (2) PH, VA; 775–1350 m; Flp, Gmg
Silene drummondii Hook. var. *striata* (Rydb.) Bocquet (10) PH, VA; 735–1145 m; Fpp, Ftw, Gmg, Sss, Wcb
**Silene latifolia* Poir. (1) PH; 1360–1450 m; Vot
Silene menziesii Hook.; *K.H. Lackschewitz 8122* (MONT); PH
Spergularia marina (L.) Griseb. (3) PH, VA; 650–800 m; Wal, Wpw
Stellaria longifolia Muhl. ex Willd. (1) PH; 1275–1350 m; Fmr
**Stellaria media* (L.) Vill.; *Anonymous s.n.* (MONT); VA
**Vaccaria hispanica* (Mill.) Rauschert; *K.H. Lackschewitz 10023* (MONTU, RM); VA

Ceratophyllaceae
Ceratophyllum demersum L. (5) PH, VA; 775–935 m; Wpw

Cleomaceae
Peritoma serrulata (Pursh) DC. (2) PH; 735–870 m; D, Wcb
Polanisia dodecandra (L.) DC. var. *trachysperma* (Torr. & A. Gray) H.H. Iltis (2) PH, VA; 650–730 m; Gmg, Wpw

Commelinaceae
Tradescantia occidentalis (Britton) Smyth var. *occidentalis* (1) VA; 670–675 m; Gmg

Convolvulaceae
Calystegia macounii (Greene) Brummitt (2) PH; 690–925 m; Wcb, Wpw
**Calystegia sepium* (L.) R. Br. var. *angulata* (Brummitt) N.H. Holmgren (2) PH, VA; 690–790 m; Wpw
*● *Convolvulus arvensis* L. (10) PH, VA; 660–945 m; D, Ftw, Gmg
Cuscuta coryli Engelm.; *J.W. Blankinship s.n.* (MONT); VA
Cuscuta pentagona Engelm. var. *pentagona* (1) VA; 715–745 m; Wpw

Cornaceae
Cornus canadensis L. (5) PH; 1195–1470 m; Flp, Fmr
Cornus sericea L. var. *sericea* (22) PH, VA; 650–1470 m; Fmr, Ftw

Crassulaceae
Sedum lanceolatum Torr. (9) PH; 1270–1735 m; Flp, Fmc, Fmr, Fpp, Gmm, Vot

Cyperaceae
Bolboschoenus fluviatilis (Torr.) Soják (2) VA; 785–895 m; Wpw
Bolboschoenus maritimus (L.) Palla ssp. *paludosus* (A. Nelson) T. Koyama (16) PH, VA; 670–930 m; Wal, Wpw
Carex atherodes Spreng. (1) VA; 800 m; Wpw
Carex aurea Nutt. (2) PH, VA; 925–1285 m; Fmr, Wcb
Carex bebbii (L.H. Bailey) Olney ex Fernald (2) PH, VA; 925–1350 m; Fmr, Wcb
Carex brevior (Dewey) Mack. ex Lunell (29) PH, VA; 670–935 m; Ftw, Wcb, Wpw
Carex deweyana Schwein. var. *deweyana* (2) PH; 1275–1470 m; Fmr
Carex disperma Dewey (1) PH; 1275–1350 m; Fmr
Carex douglasii Boott (1) VA; 670–675 m; Gmg
Carex duriuscula C.A. Mey. (26) PH, VA; 620–1145 m; Fpj, Gmg, Sss
Carex filifolia Nutt. (41) PH, VA; 620–1145 m; Fpj, Gmg, Gup, Sjw, Sss
Carex hoodii Boott (6) PH; 1270–1685 m; Fmc, Fmr, Gmm
Carex inops L.H. Bailey ssp. *heliophila* (Mack.) Crins (20) PH, VA; 620–1365 m; Fpj, Gmg, Sss
Carex laeviconica Dewey (1) PH; 700–705 m; Wpw
Carex lanuginosa Michx. (5) PH, VA; 680–1145 m; Wal, Wcb, Wpw
Carex lasiocarpa Ehrh. (1) PH; 810 m; Wcb
Carex obtusata Lilj. (1) VA; 925–960 m; Gmg
Carex praegracilis W. Boott (24) PH, VA; 675–1145 m; Wcb, Wpw
Carex rossii Boott (3) PH, VA; 800–1735 m; Gmm, Gup
♦ *Carex scoparia* Schkuhr ex Willd. var. *scoparia* (2) PH; 940–1735 m; Ftw, Gmm
Carex sprengelii Dewey ex Spreng. (2) PH, VA; 950–1230 m; Fmr, Ftw
Carex stipata Muhl. ex Willd. var. *stipata* (1) PH; 1195–1230 m; Fmr
Carex vulpinoidea Michx. (2) PH; 770–780 m; Wcb, Wpw
Cyperus squarrosus L. (1) PH; 790–795 m; Wpw
Eleocharis acicularis (L.) Roem. & Schult. (11) PH, VA; 685–915 m; Wal, Wcb, Wpw
Eleocharis palustris (L.) Roem. & Schult. (44) PH, VA; 650–935 m; Wcb, Wpw
Schoenoplectus acutus (Muhl. ex Bigelow) Á. Löve & D. Löve var. *acutus* (9) PH, VA; 670–905 m; Wpw
Schoenoplectus acutus (Muhl. ex Bigelow) Á. Löve & D. Löve var. *occidentalis* (S. Watson) S.G. Sm. (8) PH, VA; 685–935 m; Wal, Wpw
♦ *Schoenoplectus heterochaetus* (Chase) Soják; *P. Lesica 7439* (MONTU); PH
Schoenoplectus pungens (Vahl) Palla var. *pungens* (24) PH, VA; 675–930 m; Wal, Wcb, Wpw
Schoenoplectus tabernaemontani (C.C. Gmel.) Palla (11) PH, VA; 650–880 m; Wcb, Wpw
Scirpus pallidus (Britton) Fernald (1) VA; 830–890 m; Wcb

Elaeagnaceae
**Elaeagnus angustifolia* L. (18) PH, VA; 635–835 m; D, Frc, Ftw, Gmg, Wcb, Wpw
Elaeagnus commutata Bernh. ex Rydb. (4) VA; 700–990 m; Ftw, Gmg, Wcb
Shepherdia argentea (Pursh) Nutt. (35) PH, VA; 635–945 m; Ftw, Wcb, Wpw

Shepherdia canadensis (L.) Nutt. (23) PH, VA; 950–1645 m; Flp, Fmc, Fmr, Fpp, Gmm

Elatinaceae

Elatine rubella Rydb. (3) PH, VA; 745–825 m; Wpw

Ericaceae

Arctostaphylos uva-ursi (L.) Spreng. (24) PH, VA; 885–1735 m; Flp, Fmc, Fmr, Fpp, Gmm

Chimaphila umbellata (L.) W.P.C. Barton var. *occidentalis* (Rydb.) S.F. Blake (2) PH; 1275–1495 m; Flp

Moneses uniflora (L.) A. Gray (2) PH; 1275–1470 m; Flp, Fmr

Orthilia secunda (L.) House (10) PH; 1240–1735 m; Flp, Fmc, Fmr, Gmm

Pterospora andromedea Nutt. (15) PH; 1195–1735 m; Flp, Fmc, Fmr, Fpp

Pyrola asarifolia Michx. var. *asarifolia* (7) PH; 1220–1470 m; Fmc, Fmr

Pyrola chlorantha Sw. (4) PH; 1270–1735 m; Flp, Fmr

Euphorbiaceae

Chamaesyce glyptosperma (Engelm.) Small (24) PH, VA; 650–930 m; D, Frc

Chamaesyce serpens (Kunth) Small (5) PH, VA; 650–825 m; D

Chamaesyce serpyllifolia (Pers.) Small (16) PH, VA; 670–885 m; D, Sss, Vbl

*● *Euphorbia esula* L. var. *esula* (7) PH, VA; 650–815 m; Frc, Sjw, Sss, Wcb, Wpw

*● *Euphorbia esula* L. var. *uralensis* (Fisch. ex Link) Dorn (13) PH, VA; 620–915 m; D, Frc, Ftw, Gmg, Wcb, Wpw

Euphorbia spathulata Lam. (15) PH, VA; 690–1145 m; Fpj, Gmg, Sgs, Wcb

Fabaceae

Astragalus adsurgens Pall. var. *robustior* Hook. (53) PH, VA; 675–1575 m; Fpj, Ftw, Gmg, Gup, Sjw, Sss

Astragalus agrestis Douglas ex G. Don (64) PH, VA; 665–1365 m; Fpj, Ftw, Gmg, Sss, Wcb

Astragalus americanus (Hook.) M.E. Jones (3) PH; 1270–1470 m; Fmr

Astragalus bisulcatus (Hook.) A. Gray var. *bisulcatus* (47) PH, VA; 680–1050 m; D, Fpj, Gmg, Gup, Sgs, Sss, Vbl, Wcb

Astragalus canadensis L. var. *canadensis* (2) PH; 1320–1450 m; Fmc, Fpp

Astragalus cibarius E. Sheld. (2) PH, VA; 715–1160 m; Sss

**Astragalus cicer* L. (4) PH; 1260–1740 m; D, Flp, Fmc, Fmr

Astragalus crassicarpus Nutt. var. *crassicarpus* (4) PH, VA; 705–880 m; Gmg, Gup

Astragalus crassicarpus Nutt. var. *paysonii* (E.H. Kelso) Barneby (16) PH, VA; 695–1440 m; Gmg, Gmm, Gup, Sss

Astragalus drummondii Douglas ex Hook. (39) PH, VA; 675–1440 m; Gmg, Gmm, Gup, Sss

Astragalus flexuosus (Hook.) Douglas ex G. Don var. *flexuosus* (5) VA; 775–990 m; Gmg, Gup

Astragalus gilviflorus E. Sheld. var. *gilviflorus* (38) PH, VA; 655–1450 m; Fpj, Gmg, Gup, Sss

Astragalus gracilis Nutt.; *K.H. Lackschewitz 8375* (MONT, MONTU); PH

Astragalus kentrophyta A. Gray var. *kentrophyta* (1) VA; 800–840 m; Gup

Astragalus lotiflorus Hook. (7) PH, VA; 760–1050 m; Fpj, Gmg, Sss

Astragalus missouriensis Nutt. var. *missouriensis* (74) PH, VA; 655–1370 m; Gmg, Gup, Sgs, Sss

Astragalus pectinatus (Hook.) Douglas ex G. Don (38) PH, VA; 705–960 m; Gmg, Gup, Wcb

Astragalus purshii Douglas ex Hook. var. *purshii* (11) PH, VA; 695–860 m; Gmg, Sss

Astragalus spatulatus E. Sheld. (9) PH, VA; 760–925 m; Gmg, Gup

Astragalus tenellus Pursh (9) PH, VA; 745–990 m; Ftw, Gmg, Gup

**Caragana arborescens* Lam. (3) PH, VA; 685–835 m; D

Dalea candida Michx. var. *oligophylla* (Torr.) Shinners (35) PH, VA; 670–1050 m; Fpj, Gmg, Gup, Sss

Dalea purpurea Vent. var. *purpurea* (63) PH, VA; 635–1485 m; Fpj, Fpp, Gmg, Gup, Sjw, Sss

Glycyrrhiza lepidota Pursh (66) PH, VA; 635–1370 m; Fmr, Frc, Ftw, Gmg, Gup, Wcb, Wpw

Hedysarum alpinum L. var. *philoscia* (A. Nelson) Rollins (2) PH; 1275–1495 m; Flp, Gmm

Hedysarum boreale Nutt. var. *boreale* (4) PH, VA; 700–1145 m; Ftw, Gmg, Gup

Hedysarum boreale Nutt. var. *pabulare* (A. Nelson) Dorn (6) PH, VA; 730–1050 m; Fpj, Ftw, Gup

Hedysarum sulphurescens Rydb. (6) PH; 1275–1735 m; Flp, Fmc, Fmr

Lathyrus ochroleucus Hook. (4) PH; 1275–1470 m; Fmc, Fmr

**Lotus corniculatus* L. (3) PH; 1260–1740 m; D, Fmr

Lotus unifoliolatus (Hook.) Benth. var. *unifoliolatus* (3) VA; 650–835 m; Gmg, Wcb

Lupinus polyphyllus Lindl. var. *humicola* (A. Nelson) Barneby; *W.E. Booth 59559* (MONT, RM), *W.E. Booth 59560* (MONT); VA

Lupinus pusillus Pursh var. *pusillus* (16) PH, VA; 670–945 m; Gmg, Gup

**Medicago lupulina* L. (46) PH, VA; 620–1685 m; D, Fmc, Fmr, Fpj, Wcb

**Medicago sativa* L. (52) PH, VA; 635–1365 m; D, Fpj, Ftw, Gmg, Sgs, Sss, Wcb

**Melilotus albus* Medik. (7) PH, VA; 660–1340 m; D, Fmr, Gmg

**Melilotus officinalis* (L.) Pall. (110) PH, VA; 620–1350 m; D, Fpj, Gmg, Gup, Sgs, Sjw, Sss

Oxytropis besseyi (Rydb.) Blank. var. *argophylla* (Rydb.) Barneby (1) VA; 925–960 m; Gmg

Oxytropis besseyi (Rydb.) Blank. var. *besseyi* (3) PH, VA; 745–955 m; Gup

Oxytropis campestris (L.) DC. var. *spicata* Hook. (25) PH, VA; 745–990 m; Gmg

Oxytropis lambertii Pursh var. *lambertii* (30) PH, VA; 640–1145 m; Gmg, Gup, Sss

×*Oxytropis lambertii* Pursh × *Oxytropis sericea* Nutt. (3) PH, VA; 730–825 m; Gmg, Sss

Oxytropis sericea Nutt. var. *sericea* **(3)** PH; 760–975 m; Fpj, Gup

Oxytropis sericea Nutt. var. *speciosa* (Torr. & A. Gray) S.L. Welsh **(30)** PH, VA; 690–1440 m; Gmg, Gup, Sss

Oxytropis splendens Douglas ex Hook. **(8)** PH; 1220–1575 m; Flp, Fmc, Fmr, Fpp, Gmm

Pediomelum argophyllum (Pursh) J.W. Grimes **(93)** PH, VA; 635–1365 m; Fpj, Gmg, Gup, Sss, Wcb

Pediomelum esculentum (Pursh) Rydb. **(42)** PH, VA; 640–1450 m; Fpj, Gmg, Gup, Sss

Psoralidium lanceolatum (Pursh) Rydb. **(5)** VA; 730–880 m; Fpj, Ftw, Gup

Psoralidium tenuiflorum (Pursh) Rydb.; *J.W. Blankinship s.n.* (MONT); PH

Thermopsis rhombifolia (Nutt. ex Pursh) Nutt. ex Richardson var. *annulocarpa* (A. Nelson) L.O. Williams **(6)** PH, VA; 730–1160 m; Gmg, Sss

Thermopsis rhombifolia (Nutt. ex Pursh) Nutt. ex Richardson var. *rhombifolia* **(85)** PH, VA; 620–1735 m; Flp, Fpj, Ftw, Gmg, Gup, Sjw, Sss, Wcb

Trifolium aureum* Pollich **(1) PH; 1475–1495 m; Gmm

Trifolium fragiferum* L. **(1) VA; 660 m; D

Trifolium hybridum* L. **(3) PH; 670–1350 m; Fmr, Fpp, Wpw

Trifolium pratense* L. **(2) PH; 1275–1495 m; D, Gmm

Trifolium repens* L. **(8) PH, VA; 660–1490 m; D, Fmc, Fmr

Vicia americana Muhl. ex Willd. var. *americana* **(8)** PH, VA; 665–1470 m; Fmr, Fpj

Vicia americana Muhl. ex Willd. var. *minor* Hook. **(122)** PH, VA; 620–1575 m; Fpj, Gmg, Gmm, Sgs, Sjw, Sss, Wcb

Gentianaceae
Gentiana affinis Griseb. **(1)** PH; 775–780 m; Wcb
Gentianella amarella (L.) Börner var. *acuta* (Michx.) Herder **(2)** PH; 1195–1285 m; Fmr

Geraniaceae
**Erodium cicutarium* (L.) L'Hér. ex Aiton; *W. Schultz s.n.* (MONT); VA
Geranium bicknellii Britton var. *longipes* (S. Watson) Fernald **(4)** PH; 1240–1645 m; Flp, Fmc, Fmr
Geranium carolinianum L. **(1)** PH; 1335–1370 m; Fmr
Geranium richardsonii Fisch. & Trautv. **(8)** PH; 1195–1490 m; Fmr
Geranium viscosissimum Fisch. & C.A. Mey. ex C.A. Mey. var. *viscosissimum* **(1)** VA; 925–960 m; Wcb

Grossulariaceae
Ribes americanum Mill. **(1)** PH; 1245 m; Fmr
Ribes aureum Pursh var. *aureum* **(3)** PH; 710–1365 m; Fmr, Ftw
Ribes aureum Pursh var. *villosum* DC. **(18)** PH, VA; 685–1370 m; Ftw, Gmg, Gup, Wcb
Ribes cereum Douglas **(26)** PH, VA; 725–1735 m; Fpj, Gup, Sjw, Vot
Ribes lacustre (Pers.) Poir. **(1)** PH; 1275–1350 m; Fmr
Ribes oxyacanthoides L. var. *irriguum* (Douglas) Jancz. **(1)** PH; 1395–1470 m; Fmr
Ribes oxyacanthoides L. var. *oxyacanthoides* **(16)** PH, VA; 680–1685 m; Fmr, Ftw, Sjw, Vot, Wcb

Haloragaceae
Myriophyllum sibiricum Kom. **(1)** PH; 930–935 m; Wpw
Myriophyllum verticillatum L. **(1)** VA; 925–960 m; Wpw

Hydrocharitaceae
♦ *Elodea bifoliata* H. St. John **(3)** PH; 775–935 m; Wpw

Iridaceae
Sisyrinchium montanum Greene var. *montanum* **(16)** PH, VA; 690–1685 m; Ftw, Gmg, Gmm, Wcb

Juncaceae
Juncus arcticus Willd. var. *balticus* (Willd.) Trautv. **(24)** PH, VA; 685–1145 m; Wal, Wcb, Wpw
Juncus bufonius L. **(7)** PH, VA; 640–880 m; Ftw, Wal, Wcb, Wpw
Juncus dudleyi Wiegand **(2)** PH, VA; 825–960 m; Wcb
Juncus interior Wiegand **(14)** PH, VA; 735–910 m; Wcb, Wpw
Juncus longistylis Torr. **(3)** PH, VA; 775–945 m; Wal, Wcb
Juncus torreyi Coville; *K.H. Lackschewitz 8626* (MONT, MONTU); PH

Juncaginaceae
Triglochin maritima L. (8) PH, VA; 685–1145 m; Wal, Wcb, Wpw

Lamiaceae
Dracocephalum parviflorum Nutt. (2) PH; 1290–1575 m; Fmr, Gmm
Hedeoma drummondii Benth. (2) PH, VA; 830–1145 m; Fmr, Fpj
Hedeoma hispidum Pursh (55) PH, VA; 620–1050 m; Fpj, Gmg, Sss, Wcb
**Leonurus cardiaca* L. var. *cardiaca*; *M. Andersen s.n.* (MONT); VA
Lycopus americanus Muhl. ex W.P.C. Barton (1) VA; 830–890 m; Wal
Lycopus asper Greene (12) PH, VA; 650–935 m; Wpw
Mentha arvensis L. (24) PH, VA; 685–1320 m; Fmr, Frc, Wpw
Monarda fistulosa L. var. *menthifolia* (Graham) Fernald (20) PH, VA; 780–1675 m; Flp, Fmc, Fmr, Fpp, Ftw, Wcb
**Nepeta cataria* L. (1) PH; 685 m; Ftw
**Salvia nemorosa* L.; *C. Dewit s.n.* (MONT); VA
Salvia reflexa Hornem. (1) VA; 650 m; Wpw
Stachys palustris L. var. *pilosa* (Nutt.) Fernald (5) PH, VA; 685–915 m; Wcb, Wpw

Liliaceae
Calochortus nuttallii Torr. & A. Gray (15) PH, VA; 690–1145 m; Fpj, Gmg, Gup, Sss
Fritillaria pudica (Pursh) Spreng. (5) PH; 720–1365 m; Fpj, Gmg, Gmm, Wcb
Prosartes trachycarpa S. Watson (16) PH, VA; 845–1490 m; Fmc, Fmr, Ftw
Streptopus amplexifolius (L.) DC. (2) PH; 1195–1350 m; Fmr

Linaceae
Linum australe A. Heller var. *australe* (23) PH, VA; 665–990 m; Gmg, Gup, Sss
Linum compactum A. Nelson (10) PH, VA; 660–830 m; Gmg, Gup, Sss
Linum lewisii Pursh var. *lewisii* (32) PH, VA; 675–1440 m; D, Ftw, Gmg, Gup, Wcb
Linum rigidum Pursh var. *rigidum* (5) PH, VA; 675–1050 m; Fpj, Gup, Sss

Loasaceae
Mentzelia albicaulis (Douglas ex Hook.) Douglas ex Torr. & A. Gray (4) PH, VA; 700–975 m; Fpj, Gmg, Vbl
Mentzelia decapetala (Pursh ex Sims) Urb. & Gilg ex Gilg (2) PH; 855–870 m; D, Vbl
Mentzelia dispersa S. Watson (9) PH, VA; 685–885 m; Fpj, Gmg, Sjw, Vbl
Mentzelia laevicaulis (Douglas ex Hook.) Torr. & A. Gray var. *laevicaulis*; *K.H. Lackschewitz 8365* (MONT); PH
♦*Mentzelia nuda* (Pursh) Torr. & A. Gray; *W.E. Booth s.n.* (MONT); VA

Lythraceae
♦ *Ammannia robusta* Heer & Regel (1) VA; 740–745 m; Wpw

Malvaceae
**Hibiscus trionum* L.; *S.A. Simonsen s.n.* (MONT); VA
**Malva parviflora* L.; *M.G. Atwater s.n.* (MONT); PH
**Malva sylvestris* L.; *R. Feigel s.n.* (MONT); PH
Sphaeralcea coccinea (Nutt.) Rydb. (74) PH, VA; 640–1145 m; D, Fpj, Gmg, Gup, Sgs, Sss

Melanthiaceae
Zigadenus venenosus S. Watson var. *gramineus* (Rydb.) O.S. Walsh ex M. Peck (50) PH, VA; 685–1575 m; Gmg, Sss, Wcb

Myrsinaceae
♦ *Anagallis minima* (L.) E.H.L. Krause (2) PH, VA; 780–910 m; Wcb, Wpw
Glaux maritima L. (3) PH, VA; 770–1145 m; Wal, Wcb
Lysimachia ciliata L. (3) PH; 1240–1490 m; Fmc, Fmr

Nyctaginaceae
Mirabilis linearis (Pursh) Heimerl var. *linearis* (10) PH, VA; 670–945 m; Fpj, Gmg, Gup, Sgs, Sjw, Sss

Oleaceae
Fraxinus pennsylvanica Marshall (15) PH, VA; 635–825 m; Frc, Ftw, Wcb, Wpw

Onagraceae
Chamerion angustifolium (L.) Holub var. *angustifolium* (1) PH; 1485–1735 m; Vot
Chamerion angustifolium (L.) Holub var. *canescens* (A.W. Wood) N.H. Holmgren & P.K. Holmgren (9) PH; 1270–1740 m; D, Fmr, Vot
Circaea alpina L. var. *alpina* (1) PH; 1275–1350 m; Fmr
Epilobium brachycarpum C. Presl (24) PH, VA; 675–1735 m; D, Fpp, Ftw, Gmg, Wcb, Wpw
Epilobium campestre (Jeps.) Hoch & W.L. Wagner (8) PH, VA; 675–915 m; Wcb, Wpw
Epilobium ciliatum Raf. var. *ciliatum* (13) PH, VA; 770–1350 m; Fmr, Wcb, Wpw
Epilobium ciliatum Raf. var. *glandulosum* (Lehm.) Dorn (2) PH; 1240–1320 m; Fmr

Epilobium glaberrimum Barbey var. *fastigiatum* (Nutt.) Trel. ex Jeps. (1) VA; 830–890 m; Wcb
Epilobium leptophyllum Raf. (3) PH, VA; 685–835 m; Wcb, Wpw
Gayophytum diffusum Torr. & A. Gray var. *strictipes* (Hook.) Dorn (1) PH; 1720–1740 m; D
Oenothera albicaulis Pursh (6) PH, VA; 710–845 m; Ftw, Gmg, Gup, Sss
Oenothera cespitosa Nutt. var. *cespitosa* (40) PH, VA; 620–990 m; Fpj, Gmg, Gup, Sgs, Sss, Vbl
Oenothera flava (A. Nelson) Garrett (1) VA; 650–660 m; Wcb
Oenothera nuttallii Sweet (2) VA; 680–750 m; Ftw, Gmg
Oenothera pallida Lindl. var. *trichocalyx* (Nutt.) Dorn; *J.W. Blankinship s.n.* (MONT); PH
Oenothera serrulata Nutt. (6) PH, VA; 680–945 m; Fpj, Ftw, Gmg, Sss, Wcb
Oenothera suffrutescens (Ser.) W.L. Wagner & Hoch (79) PH, VA; 620–1340 m; Fpj, Gmg, Gup, Sss, Vbl, Wcb
Oenothera villosa Thunb. var. *strigosa* (Rydb.) Dorn (9) PH, VA; 660–1740 m; D, Fmr, Frc, Wpw

Orchidaceae

Calypso bulbosa (L.) Oakes var. *americana* (R. Br.) Luer (1) PH; 1295–1325 m; Fmc
Coeloglossum viride (L.) Hartm. (2) PH; 1260–1450 m; Fmc, Fmr
Corallorhiza maculata (Raf.) Raf. var. *occidentalis* (Lindl.) Ames (4) PH; 1335–1735 m; Flp, Fmr
Corallorhiza striata Lindl. var. *striata* (4) PH; 1195–1440 m; Fmr, Fpp
Corallorhiza wisteriana Conrad (3) PH; 1195–1440 m; Fmr, Fpp
Cypripedium montanum Douglas ex Lindl. (4) PH; 1220–1370 m; Fmc, Fmr, Fpp
Goodyera oblongifolia Raf. (1) PH; 1275–1350 m; Flp
Platanthera aquilonis Sheviak (3) PH; 1245–1370 m; Fmr

Orobanchaceae

Castilleja miniata Douglas ex Hook. var. *miniata* (6) PH; 1240–1495 m; Fmr, Gmm
Castilleja sessiliflora Pursh (12) PH, VA; 665–1145 m; Fpj, Gmg, Sss
Orobanche fasciculata Nutt. (32) PH, VA; 620–990 m; Fpj, Gmg, Gup, Sss
Orthocarpus luteus Nutt. (48) PH, VA; 675–1365 m; Fpj, Ftw, Gmg, Sss, Wcb

Oxalidaceae

**Oxalis corniculata* L.; *C. Bergsagal s.n.* (MONT); PH
Oxalis dillenii Jacq. (2) VA; 880–910 m; Wcb, Wpw

Papaveraceae

Corydalis aurea Willd. var. *aurea* (3) PH; 1160–1735 m; D, Fmr, Vot
**Fumaria vaillantii* Loisel. (1) VA; 675–720 m; Ftw

Phrymaceae

Mimulus guttatus DC. (5) PH; 1195–1395 m; Fmr

Plantaginaceae

♦ *Bacopa rotundifolia* (Michx.) Wettst. (1) PH; 815–825 m; Wpw
Besseya wyomingensis (A. Nelson) Rydb. (2) PH; 955–1365 m; Fpp
Callitriche hermaphroditica L.; *J.W. Blankinship s.n.* (MONT), *K.H. Lackschewitz 8360* (MONT), *K.H. Lackschewitz 8577* (MONT, MONTU), *K.H. Lackschewitz 8616* (MONTU); PH, VA
Callitriche heterophylla Pursh var. *heterophylla* (3) VA; 800–910 m; Wpw
Callitriche palustris L. (1) PH; 770–790 m; Wpw
Collinsia parviflora Lindl. (2) PH; 1295–1440 m; Gmm
Gratiola neglecta Torr. (5) PH; 735–790 m; Wpw
Limosella aquatica L. (11) PH, VA; 740–935 m; Wpw
Penstemon albidus Nutt. (67) PH, VA; 620–1160 m; Gmg, Gup, Sss, Wcb
Penstemon eriantherus Pursh var. *eriantherus*; *W.E. Booth 59550* (MONT); VA
Penstemon gracilis Nutt. (12) PH, VA; 690–990 m; Gmg, Wcb
♦*Penstemon grandiflorus* Nutt.; *M. Flatt s.n.* (MONT); PH
Penstemon nitidus Douglas ex Benth. var. *nitidus* (62) PH, VA; 620–1675 m; Fpj, Gmg, Gmm, Gup, Sgs, Sjw, Sss, Vbl
Penstemon procerus Douglas ex Graham var. *procerus* (13) PH, VA; 790–1735 m; Fmr, Gmg, Gmm, Wcb
Plantago elongata Pursh var. *elongata* (46) PH, VA; 620–980 m; D, Gmg, Sgs, Sss, Wcb
**Plantago major* L. (11) PH, VA; 685–1350 m; D, Fmr, Wpw
Plantago patagonica Jacq. (83) PH, VA; 635–1145 m; D, Fpj, Gmg, Gup, Sgs, Sss
Veronica americana Schwein. ex Benth. (2) PH; 1195–1320 m; Fmr
**Veronica anagallis-aquatica* L.; *K.H. Lackschewitz 8592* (MONT, MONTU); PH
**Veronica catenata* Pennell (1) VA; 650 m; Wpw
Veronica peregrina L. var. *xalapensis* (Kunth) H. St. John & F.W. Warren (32) PH, VA; 640–935 m; Gmg, Wcb, Wpw

Poaceae

Achnatherum hymenoides (Roem. & Schult.) Barkworth (36) PH, VA; 670–1145 m; Fpj, Gmg, Gup, Sss
Achnatherum nelsonii (Scribn.) Barkworth ssp. *nelsonii* (2) PH, VA; 925–1340 m; D, Wcb
Achnatherum richardsonii (Link) Barkworth; *A.W. Armstrong 52* (USFS); PH
**Agropyron cristatum* (L.) Gaertn. var. *cristatum* (45) PH, VA; 635–1225 m; D, Ftw, Gmg, Sss
**Agropyron cristatum* (L.) Gaertn. var. *desertorum* (Fisch. ex Link) Dorn (54) PH, VA; 670–990 m; D, Gmg, Sgs, Sss
Agropyron cristatum* (L.) Gaertn. var. *fragile* (Roth) Dorn **(2) PH, VA; 700–825 m; D
Agropyron triticeum* Gaertn. **(1) VA; 665–690 m; Gmg
Agrostis exarata Trin. **(3)** PH; 1195–1245 m; Fmr
Agrostis scabra Willd. **(17)** PH, VA; 740–1740 m; D, Flp, Wcb, Wpw
Agrostis stolonifera* L. **(6) PH, VA; 685–1320 m; Fmr, Wcb, Wpw
Alopecurus aequalis Sobol. var. *aequalis* **(1)** VA; 730–810 m; Wpw
Alopecurus arundinaceus* Poir. **(11) PH, VA; 635–925 m; D, Wal, Wcb, Wpw
Alopecurus carolinianus Walter **(14)** PH, VA; 720–905 m; D, Wal, Wcb, Wpw
Alopecurus geniculatus* L. **(10) PH, VA; 740–930 m; Wcb, Wpw
Aristida purpurea Nutt. var. *longiseta* (Steud.) Vasey **(9)** PH, VA; 740–935 m; Gmg, Gup, Sss
Avena fatua* L. **(2) PH; 790–1225 m; D
Avenula hookeri (Scribn.) Holub **(3)** PH, VA; 925–1145 m; Fpp, Gmg
Beckmannia syzigachne (Steud.) Fernald **(38)** PH, VA; 635–935 m; Frc, Wcb, Wpw
Bouteloua gracilis (Kunth) Lag. ex Griffiths **(79)** PH, VA; 635–1050 m; Fpj, Gmg, Gup, Sgs, Sjw, Sss
Bromus ciliatus L. **(2)** PH; 1270–1395 m; Flp, Fmr
Bromus commutatus* Schrad. **(3) PH, VA; 690–905 m; D, Sss
Bromus inermis* Leyss. **(47) PH, VA; 635–1490 m; D, Fmr, Frc, Ftw, Gmg, Wcb, Wpw
Bromus japonicus* Thunb. ex Murray **(82) PH, VA; 620–1575 m; D, Fpj, Gmg, Sgs, Sjw, Sss, Wcb
Bromus porteri (J.M. Coult.) Nash **(3)** PH; 1320–1735 m; Fpp, Gmm
Bromus pumpellianus Scribn. **(3)** PH, VA; 660–1685 m; D, Fmc
Bromus richardsonii Link **(5)** PH; 1195–1740 m; D, Fmr
Bromus squarrosus* L. **(7) PH, VA; 640–905 m; D, Gmg, Sss
Bromus tectorum* L. **(37) PH, VA; 660–1735 m; D, Ftw, Gmg, Gmm, Gup, Sss
Buchloë dactyloides (Nutt.) Engelm.; *L. Lindgren s.n.* (MONT); VA
Calamagrostis canadensis (Michx.) P. Beauv. var. *canadensis* **(3)** PH; 1270–1470 m; Fmr

Calamagrostis inexpansa A. Gray **(1)** VA; 830–835 m; Wpw
Calamagrostis montanensis (Scribn.) Scribn. **(11)** PH, VA; 660–1145 m; Fpj, Fpp, Gmg, Sjw, Sss
Calamagrostis purpurascens R. Br. **(4)** PH; 1355–1735 m; Flp, Fmc, Gmm
Calamovilfa longifolia (Hook.) Scribn. var. *longifolia* **(31)** PH, VA; 685–975 m; Fpj, Gmg, Gup, Sgs, Sss
Cinna latifolia (Trevir. ex Göpp.) Griseb. **(1)** PH; 1195–1230 m; Fmr
Crypsis alopecuroides* (Piller & Mitterp.) Schrad. **(1) PH; 690 m; Frc
Danthonia spicata (L.) P. Beauv. ex Roem. & Schult. **(6)** PH; 1270–1675 m; Flp, Fmc, Fmr, Fpp
Danthonia unispicata (Thurb.) Munro ex Macoun **(4)** PH, VA; 790–930 m; Gmg, Wcb
Deschampsia cespitosa (L.) P. Beauv. var. *cespitosa* **(7)** PH, VA; 775–960 m; Wcb, Wpw
Distichlis spicata (L.) Greene **(25)** PH, VA; 675–1050 m; Sgs, Sss, Wal, Wpw
Echinochloa muricata (P. Beauv.) Fernald var. *microstachya* Wiegand **(23)** PH, VA; 650–935 m; D, Frc, Wpw
Elymus albicans (Scribn. & J.G. Sm.) Á. Löve **(5)** PH, VA; 755–1450 m; Fpj, Fpp, Gup
Elymus canadensis L. var. *canadensis* **(16)** PH, VA; 685–1145 m; Ftw, Wcb, Wpw
Elymus cinereus Scribn. & Merr. **(1)** PH; 705–730 m; D
Elymus elongatus* (Host) Runemark var. *ponticus* (Podp.) Dorn **(1) VA; 635–655 m; Gmg
Elymus elymoides (Raf.) Swezey var. *brevifolius* (J.G. Sm.) Dorn **(4)** PH; 740–820 m; Gmg, Gup, Sss
Elymus elymoides (Raf.) Swezey var. *elymoides* **(26)** PH, VA; 640–955 m; Gmg, Gup, Sgs, Sss
Elymus glaucus Buckley var. *glaucus* **(3)** PH; 1335–1495 m; Fmr, Gmm
Elymus hispidus* (Opiz) Melderis var. *hispidus* **(4) PH; 790–1740 m; D, Fmc
Elymus hispidus* (Opiz) Melderis var. *ruthenicus* (Griseb.) Dorn **(2) PH; 675–685 m; D, Frc
Elymus lanceolatus (Scribn. & J.G. Sm.) Gould var. *lanceolatus* **(19)** PH, VA; 730–1645 m; D, Gmg, Vbl
Elymus lanceolatus (Scribn. & J.G. Sm.) Gould var. *riparius* (Scribn. & J.G. Sm.) Dorn **(17)** PH, VA; 680–1450 m; D, Gmg
Elymus ×macounii Vasey **(1)** PH; 865–870 m; Gmg
Elymus repens* (L.) Gould **(19) PH, VA; 685–1470 m; Fmc, Fmr, Ftw, Sgs, Wcb, Wpw
Elymus ×saundersii Vasey **(2)** PH, VA; 805–835 m; D, Sgs
Elymus smithii (Rydb.) Gould **(121)** PH, VA; 620–1145 m; D, Fpj, Gmg, Sgs, Sjw, Sss, Vbl
Elymus spicatus (Pursh) Gould **(38)** PH, VA; 620–1735 m; Fmc, Fpj, Gmg, Gup, Sss
Elymus trachycaulus (Link) Gould ex Shinners ssp. *subsecundus* (Link) Á. Löve & D. Löve **(9)** PH, VA; 700–1735 m; Fmc, Fmr, Ftw, Gmg, Gmm, Gup, Wcb
Elymus trachycaulus (Link) Gould ex Shinners var. *trachycaulus* **(42)** PH, VA; 675–1685 m; D, Fpj, Fpp, Ftw, Gmg, Sgs, Vbl, Wcb, Wpw
Eragrostis cilianensis* (All.) Vignolo ex Janch. **(13) PH, VA; 660–830 m; D, Frc
Eragrostis hypnoides (Lam.) Britton, Sterns, & Poggenb. **(1)** PH; 690 m; Frc
Festuca campestris Rydb. **(1)** PH; 1380–1440 m; Gmm
Festuca hallii (Vasey) Piper **(1)** VA; 925–960 m; Gmg
Festuca saximontana Rydb. var. *saximontana* **(9)** PH, VA; 810–1735 m; Flp, Fpp, Gmg, Gmm
Glyceria grandis S. Watson var. *grandis*; *P. Lesica 8111* (MONTU); PH
Glyceria striata (Lam.) Hitchc. **(2)** PH; 1195–1320 m; Fmr
Hesperostipa comata (Trin. & Rupr.) Barkworth var. *comata* **(86)** PH, VA; 620–1145 m; Fpj, Gmg, Gup, Sgs, Sjw, Sss
Hesperostipa curtiseta (Hitchc.) Barkworth **(8)** PH, VA; 775–990 m; Ftw, Gmg
Hordeum jubatum L. ssp. *intermedium* Bowden **(59)** PH, VA; 635–1145 m; D, Gmg, Sgs, Sss, Vbl, Wal, Wcb, Wpw
Hordeum jubatum L. ssp. *jubatum* **(66)** PH, VA; 620–1740 m; D, Gmg, Sss, Wal, Wcb, Wpw
Hordeum pusillum Nutt. **(4)** PH; 705–790 m; D, Sgs, Sss
Hordeum vulgare* L. var. *vulgare* **(1) VA; 745–805 m; Ftw
Koeleria macrantha (Ledeb.) Schult. **(110)** PH, VA; 620–1735 m; Fpj, Gmg, Gmm, Gup, Sss, Wcb
**Leptochloa fusca* (L.) Kunth ssp. *fascicularis* (Lam.) N. Snow; *P. Lesica 4590* (MONTU), *D.W. Messer s.n.* (MONT); PH
**Lolium persicum* Boiss. & Hohen.; *S. Bradley s.n.* (MONT), *V.D. Luft s.n.* (MONT), *A. Solberg s.n.* (MONT), *Anonymous s.n.* (MONT); PH, VA
Muhlenbergia asperifolia (Nees & Meyen ex Trin.) Parodi **(1)** PH; 740–750 m; Wcb
Muhlenbergia cuspidata (Torr. ex Hook.) Rydb. **(2)** PH, VA; 670–730 m; Ftw, Gmg
Muhlenbergia racemosa (Michx.) Britton, Sterns, & Poggenb.; *J.W. Blankinship s.n.* (MONTU), *S.L. Bradley s.n.* (MONT); PH, VA
Muhlenbergia richardsonis (Trin.) Rydb. **(3)** PH, VA; 830–910 m; Wcb
Munroa squarrosa (Nutt.) Torr. **(10)** PH, VA; 670–825 m; D
Nassella viridula (Trin.) Barkworth **(100)** PH, VA; 620–1735 m; Fpj, Ftw, Gmg, Gmm, Gup, Sgs, Sjw, Sss, Wcb
Oryzopsis asperifolia Michx. **(4)** PH; 1270–1470 m; Flp, Fmc, Fmr
Panicum capillare L. ssp. *capillare* **(7)** PH, VA; 660–810 m; D, Frc, Wcb, Wpw
Phalaris arundinacea L. **(3)** PH, VA; 635–700 m; Frc, Wpw
Phleum alpinum L. var. *alpinum* **(1)** PH; 1395–1470 m; Fmr
Phleum pratense* L. var. *pratense* **(18) PH; 770–1685 m; D, Fmc, Fmr, Wcb, Wpw
Phragmites australis (Cav.) Trin. ex Steud. **(2)** PH, VA; 650–670 m; Frc, Wpw
Piptatherum micranthum (Trin. & Rupr.) Barkworth **(9)** PH, VA; 680–975 m; Fpj, Ftw, Sjw, Wcb
Poa arida Vasey **(27)** PH, VA; 660–990 m; Gmg, Sgs, Sss, Wcb, Wpw
Poa compressa* L. **(20) PH, VA; 685–1740 m; D, Flp, Fmr, Fpp, Wcb, Wpw
Poa cusickii Vasey var. *pallida* (Soreng) Dorn **(10)** PH, VA; 710–1005 m; Gmg, Sss, Wcb
Poa fendleriana (Steud.) Vasey ssp. *fendleriana* **(1)** VA; 880–920 m; Gmg
Poa glauca ssp. *glauca* **(1)** PH; 1485–1735 m; Vot
Poa interior Rydb. **(9)** PH; 955–1735 m; Flp, Fmc, Fmr, Fpp, Gmm
Poa nervosa var. *wheeleri* **(3)** PH; 1195–1645 m; Fmc, Fmr, Fpp
Poa palustris L. **(33)** PH, VA; 635–1645 m; Fmr, Ftw, Wcb, Wpw
Poa pratensis* L. **(92) PH, VA; 620–1735 m; D, Fmr, Ftw, Gmg, Gmm, Wcb, Wpw
Poa secunda J. Presl ssp. *juncifolia* (Scribn.) Soreng **(59)** PH, VA; 620–1685 m; Fpj, Gmg, Sgs, Sjw, Sss, Wcb, Wpw
Poa secunda J. Presl ssp. *secunda* **(67)** PH, VA; 620–990 m; Fpj, Gmg, Sgs, Sss, Wcb
Polypogon monspeliensis* (L.) Desf. **(12) PH, VA; 635–935 m; Frc, Wpw
Puccinellia distans (L.) Parl. **(1)** VA; 660 m; D
Puccinellia nuttalliana (Schult.) Hitchc. **(34)** PH, VA; 640–1145 m; Gmg, Sgs, Sss, Vbl, Wal, Wcb, Wpw
Schedonnardus paniculatus (Nutt.) Trel. **(14)** PH, VA; 640–970 m; D, Gmg, Sss
Schedonorus arundinaceus* (Schreb.) Dumort. **(1) PH; 1335–1370 m; Fmr
Schedonorus pratensis* (Huds.) P. Beauv. **(1) PH; 1240–1320 m; Fmr
Schizachne purpurascens (Torr.) Swall. **(2)** PH; 1275–1470 m; Flp, Fmr
Schizachyrium scoparium (Michx.) Nash var. *scoparium* **(17)** PH, VA; 685–1365 m; Ftw, Gup, Sjw, Sss

Setaria viridis (L.) P. Beauv. **(7)** PH, VA; 650–870 m; D, Frc
Spartina gracilis Trin. **(14)** PH, VA; 680–945 m; Wal, Wcb, Wpw
Spartina pectinata Link **(12)** PH, VA; 690–1145 m; Wal, Wcb, Wpw
♦ *Sphenopholis intermedia* (Rydb.) Rydb. **(1)** PH; 1355–1390 m; Fmc
Sphenopholis obtusata (Michx.) Scribn. **(1)** PH; 790–795 m; Wpw
Sporobolus airoides (Torr.) Torr. **(1)** PH; 955–1145 m; Wal
Sporobolus cryptandrus (Torr.) A. Gray **(5)** PH, VA; 660–825 m; D, Gmg
Triticum aestivum L. **(3)** PH, VA; 745–835 m; D, Vbl
Vulpia octoflora (Walter) Rydb. var. *glauca* (Nutt.) Fernald **(7)** PH, VA; 670–840 m; Gmg, Gup, Sss
Vulpia octoflora (Walter) Rydb. var. *octoflora* **(22)** PH, VA; 660–855 m; Gmg, Sss

Polemoniaceae
Collomia linearis Nutt. (88) PH, VA; 620–1740 m; D, Fpj, Gmg, Gup, Sgs, Sjw, Sss, Wcb
Leptosiphon septentrionalis (H. Mason) J.M. Porter & L.A. Johnson (2) PH, VA; 775–865 m; Gmg, Sss
Navarretia saximontana S.C. Spencer (8) PH, VA; 650–910 m; Wcb, Wpw
Phlox alyssifolia Greene (9) PH, VA; 670–1440 m; Fmc, Fpp, Ftw, Gmg, Gup, Sjw
♦ *Phlox andicola* E.E. Nelson (1) PH; 940–980 m; Sss
Phlox hoodii Richardson (43) PH, VA; 655–1440 m; Gmg, Gup, Sgs, Sss

Polygalaceae
Polygala alba Nutt. (10) PH, VA; 660–890 m; Gmg, Wcb
Polygala verticillata L. (2) PH, VA; 730–815 m; Fpj

Polygonaceae
Eriogonum cernuum Nutt. (2) VA; 730–880 m; Gup
Eriogonum flavum Nutt. var. *flavum* (50) PH, VA; 640–1145 m; Gmg, Gup, Sss
Eriogonum ovalifolium Nutt. var. *ochroleucum* (Small ex Rydb.) M. Peck (5) PH; 850–1145 m; Fpj, Gmg, Gup
Eriogonum ovalifolium Nutt. var. *purpureum* (Nutt.) T. Durand (1) PH; 1485–1735 m; Vot
Eriogonum pauciflorum Pursh (55) PH, VA; 670–1050 m; Fpj, Gmg, Gup, Sgs, Sss, Vbl
Eriogonum umbellatum Torr. var. *majus* Hook.; *A.W. Armstrong 27* (USFS); PH
Fallopia convolvulus (L.) Á. Löve (25) PH, VA; 650–1145 m; D, Frc, Ftw, Gmg, Wcb, Wpw
Persicaria amphibia (L.) Gray (27) PH, VA; 635–935 m; Wcb, Wpw
Persicaria lapathifolia (L.) Gray (11) PH, VA; 650–935 m; Wcb, Wpw
Persicaria maculosa Gray (1) PH; 675–680 m; Ftw
Polygonum achoreum S.F. Blake (8) PH, VA; 650–905 m; D
Polygonum aviculare L. (106) PH, VA; 620–1740 m; D, Gmg, Sgs, Sjw, Sss, Vbl, Wal, Wcb, Wpw
Polygonum douglasii Greene (16) PH, VA; 675–1575 m; Ftw, Gmg, Wcb
Polygonum erectum L. (2) PH, VA; 705–975 m; D, Sgs
Polygonum ramosissimum Michx. var. *ramosissimum* (13) PH, VA; 635–935 m; Fpj, Gmg, Wcb
Rumex crispus L. **(12)** PH, VA; 740–1320 m; Fmr, Wcb, Wpw
Rumex fueginus Phil. **(4)** PH, VA; 635–825 m; Wpw
Rumex occidentalis S. Watson **(2)** VA; 830–905 m; Wcb, Wpw
Rumex patientia L. **(4)** PH, VA; 650–870 m; Wcb, Wpw
Rumex stenophyllus Ledeb. **(24)** PH, VA; 635–905 m; Wal, Wcb, Wpw
Rumex triangulivalvis (Danser) Rech. f. **(26)** PH, VA; 670–1740 m; Wcb, Wpw
Rumex utahensis Rech. f. **(19)** PH, VA; 650–910 m; Ftw, Wcb, Wpw
Rumex venosus Pursh **(2)** VA; 665–845 m; Gmg

Portulacaceae
Lewisia rediviva Pursh **(1)** PH; 785 m; Gmg
Portulaca oleracea L. **(3)** PH, VA; 675–825 m; D

Potamogetonaceae
Potamogeton diversifolius Raf. **(1)** PH; 815–825 m; Wpw
Potamogeton foliosus Raf. var. *foliosus*; *K.H. Lackschewitz 8602* (MONT), *K.H. Lackschewitz 8614* (MONT, MONTU); PH
Potamogeton friesii Rupr.; *P. Lesica 3134* (MONTU, RM); PH
Potamogeton pusillus L. var. *pusillus* **(1)** VA; 830–890 m; Wpw
Potamogeton richardsonii (A. Benn.) Rydb. **(7)** PH, VA; 775–960 m; Wpw
Potamogeton zosteriformis Fernald **(1)** PH; 810 m; Wpw
Stuckenia pectinata (L.) Börner **(8)** PH, VA; 675–935 m; Wpw
Zannichellia palustris L. **(1)** PH; 690–700 m; Wpw

Primulaceae
Androsace occidentalis Pursh (31) PH, VA; 620–1365 m; Gmg, Sss, Wcb
Androsace septentrionalis L. (15) PH, VA; 735–925 m; Gmg, Wcb
Primula conjugens (Greene) A.R. Mast & Reveal var. *conjugens* (2) PH; 1195–1370 m; Fpp, Gmm
Primula pauciflora (Greene) A.R. Mast & Reveal var. *pauciflora* (1) VA; 925–960 m; Wcb

Ranunculaceae
Actaea rubra (Aiton) Willd. (8) PH; 1195–1490 m; Fmc, Fmr
Anemone cylindrica A. Gray (5) PH; 1195–1485 m; Flp, Fmc, Fmr
Anemone multifida Poir. var. *multifida* (12) PH, VA; 680–1735 m; Fmc, Fmr, Fpp, Ftw, Gmm
Anemone patens L. var. *multifida* Pritz. (16) PH, VA; 670–1440 m; Fpp, Gmg, Gmm, Wcb
Clematis columbiana (Nutt.) Torr. & A. Gray var. *tenuiloba* (A. Gray) J.S. Pringle (1) PH; 1255–1440 m; Fpp
Clematis ligusticifolia Nutt. (4) PH, VA; 650–750 m; Frc, Ftw
Clematis occidentalis (Hornem.) DC. var. *grosseserrata* (Rydb.) J.S. Pringle (13) PH; 1195–1490 m; Flp, Fmc, Fmr
Delphinium bicolor Nutt. ssp. *bicolor* (5) PH, VA; 880–1440 m; Fmr, Gmg, Gmm
Myosurus minimus L. (8) PH, VA; 690–830 m; Wcb, Wpw
Ranunculus abortivus L. (2) PH; 1195–1320 m; Fmr
Ranunculus aquatilis L. var. *diffusus* With. (7) PH, VA; 770–1320 m; Fmr, Wpw
Ranunculus cymbalaria Pursh (12) PH, VA; 650–960 m; Wal, Wcb, Wpw
Ranunculus glaberrimus Hook. var. *ellipticus* (Greene) Greene (3) VA; 820–925 m; Wcb
♦ *Ranunculus hyperboreus* Rottb. (1) VA; 830–835 m; Wpw
Ranunculus macounii Britton (6) PH, VA; 830–1350 m; Fmr, Wpw
Ranunculus testiculatus Crantz (1) VA; 725 m; D
Thalictrum occidentale A. Gray (5) PH, VA; 780–1470 m; Fmr, Ftw
Thalictrum venulosum Trel. (2) PH; 800–1285 m; Fmr, Ftw

Rhamnaceae
Ceanothus velutinus Douglas ex Hook. var. *velutinus* (4) PH; 1250–1735 m; Flp, Fmc, Vot

Rosaceae
Agrimonia striata Michx. (6) PH; 885–1395 m; Fmr, Ftw
Amelanchier alnifolia (Nutt.) Nutt. ex M. Roem. var. *alnifolia* (19) PH, VA; 685–1575 m; Fmr, Fpp, Ftw
Chamaerhodos erecta (L.) Bunge var. *parviflora* (Nutt.) C.L. Hitchc. (10) PH, VA; 640–1450 m; Gmg, Gup, Sss, Vot
Cotoneaster lucidus Schltdl. (1) VA; 830–835 m; D
Crataegus chrysocarpa Ashe var. *chrysocarpa* (4) PH; 895–1440 m; Fmr, Ftw
Crataegus macracantha Lodd. ex Loudon var. *occidentalis* (Britton) Eggl. (1) PH; 1295–1325 m; Fmr
Dasiphora fruticosa (L.) Rydb. (19) PH, VA; 845–1740 m; Flp, Fmc, Fmr, Fpp, Ftw, Gmg, Gmm, Vot, Wcb

Drymocallis arguta (Pursh) Rydb. (20) PH, VA; 620–1575 m; Fmc, Ftw, Gmg, Sss, Wcb
Drymocallis glabrata Rydb. (11) PH; 805–1735 m; Flp, Fmc, Fmr, Fpp, Gmm
Fragaria vesca L. (1) VA; 870–910 m; Wcb
Fragaria virginiana Mill. **(9)** PH; 1195–1575 m; Flp, Fmc, Fmr, Fpp
Geum aleppicum Jacq. **(9)** PH, VA; 775–1395 m; Fmr, Ftw, Wcb
Geum macrophyllum Willd. var. *perincisum* (Rydb.) Raup **(3)** PH; 1220–1350 m; Flp, Fmr
Geum triflorum Pursh var. *triflorum* **(61)** PH, VA; 660–1575 m; Fpj, Fpp, Ftw, Gmg, Gmm, Sss, Wcb
Malus pumila* Mill. **(1) PH; 685–690 m; D
Potentilla anserina L. **(8)** PH, VA; 650–960 m; Wcb, Wpw
Potentilla biennis Greene; *M. Lavin s.n.* (MONT); PH
Potentilla bipinnatifida Douglas ex Hook. var. *bipinnatifida* **(37)** PH, VA; 640–970 m; Gmg, Gup, Wcb
Potentilla concinna Richardson var. *concinna* **(15)** PH, VA; 695–1440 m; Gmg, Wcb
Potentilla gracilis Douglas ex Hook. var. *elmeri* (Rydb.) Jeps. **(2)** VA; 685–960 m; Wcb
Potentilla gracilis Douglas ex Hook. var. *fastigiata* (Nutt.) S. Watson **(6)** PH, VA; 690–990 m; Ftw, Gmg, Wcb
Potentilla gracilis Douglas ex Hook. var. *pulcherrima* (Lehm.) Fernald **(18)** PH, VA; 740–1495 m; Fmr, Ftw, Gmm
Potentilla hippiana Lehm. var. *effusa* (Douglas ex Lehm.) Dorn **(6)** PH; 955–1735 m; Flp, Fmc, Gmm, Gup, Vot
Potentilla hippiana Lehm. var. *hippiana* **(15)** PH, VA; 755–960 m; Gmg, Sss, Wcb
Potentilla norvegica L. ssp. *monspeliensis* (L.) Asch. & Graebn. **(9)** PH, VA; 770–1645 m; D, Fmc, Fmr, Wcb, Wpw
Potentilla paradoxa Nutt.; *W.E. Booth 57633* (MONT), *K.H. Lackschewitz 8063* (MONT, MONTU), *P. Lesica 4593* (MONTU), *P. Lesica 7835* (MONTU); PH, VA
Potentilla pensylvanica L. var. *pensylvanica* **(12)** PH, VA; 725–1145 m; Gmg, Gup, Sss, Wcb
♦*Potentilla plattensis* Nutt.; *P. Lesica 9186* (MONTU); VA
Potentilla rivalis Nutt. var. *millegrana* (Engelm. ex Lehm.) S. Watson **(3)** PH, VA; 635–865 m; Wpw
Prunus americana Marshall **(1)** VA; 830–835 m; Wcb
Prunus pensylvanica L. f. **(10)** PH; 845–1685 m; Fmc, Fmr, Ftw, Vot
Prunus virginiana L. var. *melanocarpa* (A. Nelson) Sarg. **(62)** PH, VA; 635–1735 m; Fmr, Fpp, Frc, Ftw, Wcb
Rosa arkansana Porter var. *arkansana* **(10)** PH, VA; 675–955 m; Fpj, Ftw, Gmg, Gup
Rosa arkansana Porter var. *suffulta* (Greene) Cockerell **(33)** PH, VA; 685–1450 m; Fmc, Fpj, Fpp, Ftw, Gmg, Sss, Wcb, Wpw
Rosa nutkana C. Presl var. *hispida* Fernald **(10)** PH, VA; 830–1735 m; Flp, Fmr, Fpj, Ftw, Vot
Rosa sayi Schwein. **(41)** PH, VA; 620–1575 m; Fmr, Gmg, Gup, Sjw, Sss
Rosa woodsii Lindl. var. *woodsii* **(83)** PH, VA; 650–1675 m; D, Fpj, Frc, Ftw, Gmg, Gup, Wcb, Wpw
Rubus idaeus L. var. *aculeatissimus* Regel & Tiling **(17)** PH, VA; 845–1740 m; Fmc, Fmr, Ftw, Vot
Rubus parviflorus Nutt. var. *parviflorus* **(1)** PH; 1270–1395 m; Flp
Spiraea betulifolia Pall. var. *lucida* (Douglas ex Hook.) C.L. Hitchc. **(15)** PH; 1195–1740 m; Flp, Fmc, Fmr, Fpp

Rubiaceae

Galium aparine L. **(9)** PH, VA; 685–1145 m; Ftw, Wcb
Galium boreale L. **(27)** PH, VA; 770–1735 m; Flp, Fmc, Fmr, Fpp, Ftw, Gmg, Gmm
Galium triflorum Michx. **(12)** PH, VA; 755–1735 m; Fmc, Fmr, Ftw

Salicaceae

Populus angustifolia E. James (1) PH; 1290–1340 m; Fmr
Populus balsamifera L. var. *balsamifera* (3) PH; 685–1340 m; Fmr
Populus ×brayshawii B. Boivin (2) PH; 1245–1440 m; Fmr
Populus deltoides W. Bartram ex Marshall var. *occidentalis* Rydb. (45) PH, VA; 635–1370 m; Frc, Ftw, Wcb, Wpw
Populus tremuloides Michx. (26) PH, VA; 845–1685 m; Fmc, Fmr, Fpp, Ftw
Salix amygdaloides Andersson (35) PH, VA; 635–960 m; Frc, Wpw
Salix bebbiana Sarg. (7) PH; 1195–1440 m; Fmr
Salix eriocephala Michx. var. *famelica* (C.R. Ball) Dorn (6) PH, VA; 650–890 m; Frc, Ftw, Wpw
Salix eriocephala Michx. var. *watsonii* (Bebb) Dorn (2) VA; 680–865 m; Wcb
Salix exigua Nutt. ssp. *exigua*; *K.H. Lackschewitz 8148* (MONT, MONTU); PH
Salix exigua Nutt. ssp. *interior* (Rowlee) Cronquist (26) PH, VA; 650–960 m; Frc, Wpw
**Salix fragilis* L. (1) VA; 830–835 m; Wcb
Salix scouleriana Barratt ex Hook. (9) PH; 1245–1735 m; Flp, Fmc, Fmr

Santalaceae

Comandra umbellata (L.) Nutt. var. *pallida* (A. DC.) M.E. Jones (79) PH, VA; 620–1440 m; Fpj, Gmg, Gup, Sjw, Sss

Sapindaceae

Acer negundo L. var. *interius* (Britton) Sarg. (11) PH, VA; 635–970 m; Frc, Ftw, Wpw
Acer negundo L. var. *violaceum* (Kirchn.) Jacq. (1) PH; 675–685 m; Frc

Sarcobataceae

Sarcobatus vermiculatus (Hook.) Torr. (69) PH, VA; 620–1005 m; Fpj, Sgs, Sss, Vbl

Saxifragaceae

Heuchera parvifolia Nutt. ex Torr. & A. Gray (4) PH; 955–1735 m; Fmr, Fpp, Vot
Heuchera richardsonii R. Br. (7) VA; 770–990 m; Ftw, Gmg, Wcb
Lithophragma parviflorum (Hook.) Nutt. ex Torr. & A. Gray (1) PH; 1245–1370 m; Fmr
Saxifraga occidentalis S. Watson (1) PH; 1585–1645 m; Fmr

Scrophulariaceae

**Verbascum thapsus* L. (5) PH; 1225–1740 m; D, Fmr

Smilacaceae

Smilax lasioneura Hook.; *L. Thompson 1873* (MONTU); PH

Solanaceae

**Lycium barbarum* L.; *V. Koenig s.n.* (MONT), *D. Skybery s.n.* (MONT); VA
Physalis longifolia Nutt.; *A.G. Thorsen s.n.* (MONT); VA
**Solanum physalifolium* Rusby var. *nitidibaccatum* (Bitter) Edmonds; *Anonymous s.n.* (MONT); VA
Solanum rostratum Dunal; *J.W. Blankinship s.n.* (MONT), *V. Koenig s.n.* (MONT); VA
Solanum triflorum Nutt. (8) PH, VA; 650–930 m; D, Ftw, Gmg

Tamaricaceae

*●*Tamarix chinensis* Lour. (3) VA; 685–785 m; Wcb, Wpw

Typhaceae

Sparganium eurycarpum Engelm. ex A. Gray; *J. Berger s.n.* (MONT); VA
Typha angustifolia L. (4) PH, VA; 675–835 m; Wpw
Typha ×glauca Godr.; *M.G. Atwater s.n.* (MONT); PH
Typha latifolia L. (12) PH, VA; 670–930 m; Wpw

Ulmaceae

Ulmus americana L. (1) PH; 685–690 m; D
**Ulmus pumila* L. (2) VA; 660–835 m; D

Urticaceae

Parietaria pensylvanica Muhl. ex Willd. (30) PH, VA; 675–1145 m; Fmr, Fpj, Ftw, Sgs

Urtica dioica L. var. *procera* (Muhl. ex Willd.) Wedd. (16) PH, VA; 650–1275 m; Frc, Ftw, Wcb, Wpw

Verbenaceae

Verbena bracteata Lag. & Rodr. (14) PH, VA; 650–935 m; D

Violaceae

Viola adunca Sm. var. *adunca* (5) PH; 1195–1440 m; Flp, Fmc, Fmr, Fpp

Viola canadensis L. (10) PH, VA; 950–1470 m; Fmr, Ftw, Gmm

Viola nephrophylla Greene (1) VA; 925–960 m; Wcb

Viola nuttallii Pursh (35) PH, VA; 620–1440 m; Fpj, Gmg, Gup, Sjw, Sss, Wcb

Viola vallicola A. Nelson (15) PH, VA; 710–1440 m; Gmg, Gmm, Wcb

Vitaceae

Parthenocissus vitacea (Knerr) Hitchc.; *B. Cornwell s.n.* (MONT); VA

Zygophyllaceae

**Peganum harmala* L.; *J.H. Rumely s.n.* (MONT), *J. Yeska s.n.* (MONT), *M. Yeska s.n.* (MONT); PH, VA

ACKNOWLEDGMENTS

Funding for this study was provided by the Montana/Dakotas BLM, Dr. Thomas Ford (Aven Nelson Fellowship in Systematic Botany), and the University of Wyoming. We thank John Carlson and Wendy Velman of the Montana/Dakotas BLM for facilitating the project. Lawrence Schmidt of UW Libraries was also instrumental in the project's creation.

The following individuals are greatly thanked for providing access for collecting, logistical support, or on-the-ground knowledge of the area: Stephen Klessens and Raymond Neumiller of the Glasgow BLM Field Office, Richard Adams of the Malta BLM Field Office, Robert Skinner and Aaron Johnson of Charles M. Russell National Wildlife Refuge, Jessica Larson of Bowdoin National Wildlife Refuge, Shawn Cleveland of The Nature Conservancy, and Damien Austin of the American Prairie Reserve. Damien Austin, Katie Butts, Michael Dolan, Mary Frieze, Joshua Lamp, Mark Majerus, Matthew Ocko, Noorjahan Parwana, Alice Sawyer, and Benjamin Wagner provided collecting help.

Matt Lavin and David Dyer are acknowledged for providing access to MONT and MONTU respectively to verify "historical" collections. The first author thanks committee members that included Gregory Brown and Larry Munn for their time and efforts improving this manuscript. Reviewers Mark Gabel and Peter Lesica are recognized for their helpful comments on the manuscript.

REFERENCES

Adams, R.P. 2011. Junipers of the world: the genus *Juniperus*, 3rd ed. Trafford Publ. Co., Bloomington, IN.

Alden, W.C. 1932. Physiography and glacial geology of eastern Montana and adjacent areas. Profess. Pap. U.S. Geol. Surv. 174:1–133.

Auble, G.T. and M.L. Scott. 1998. Fluvial disturbance patches and cottonwood recruitment along the upper Missouri River, Montana. Wetlands 18:546–556.

Bandy, R.G., R. Raney, K. Sullivan, and N. Svendsen. 2004. Soil survey of Phillips County area, Montana. USDA, Nat. Resources Conservation Serv., in coop. with U.S. Dept. Interior, Bur. Land Managem., and Montana Agric. Exp. Sta.

Barnosky, C.W. 1989. Postglacial vegetation and climate in the northwestern Great Plains of Montana. Quatern. Res. 31:57–73.

Bingham, L., L.A. Daniels, J.H. Smith, and M.J. Koehler. 1984. Soil survey of Valley County, Montana. USDA, Soil Conservation Serv., in coop. with Montana Agric. Exp. Sta.

Breitung, A.J. 1954. A botanical survey of the Cypress Hills. Canad. Field-Naturalist 68:55–91.

Budd, A.S. 1979. Budd's flora of the Canadian prairie provinces. Agric. Canada Publ. 1662.

Collier, A.J. 1918. Geology of northeastern Montana. Profess. Pap. U.S. Geol. Surv. 120:17–39.

Colton, R.B., R.W. Lemke, and R.M. Lindvall. 1961. Glacial map of Montana east of the Rocky Mountains. Misc. Geol. Invest. Map I-327 (map scale 1:500,000).

Colwell, R.K. 2013. EstimateS: statistical estimation of species richness and shared species from samples, version 9.1. URL: http://purl.oclc.org/estimates. Accessed 18 Jun 2013.

Colwell, R.K. and J.A. Coddington. 1994. Estimating terrestrial biodiversity through extrapolation. Philos. Trans., Ser. B 345:101-118.

Cooper, S.V., C. Jean, and P. Hendricks. 2001. Biological survey of a prairie landscape in Montana's glaciated plains. Rep. Bur. Land Managem., Agreement No. 1422E930A960015, Task Order No. 25. Montana Nat. Heritage Program, Helena.

Cooper, S.V., P. Lesica and G.M. Kudray. 2011. Post-fire recovery of Wyoming big sagebrush steppe in central and southeast Montana. Nat. Resources Environm. Issues 16:79–87.

Coupland, R.T. 1961. A reconsideration of grassland classification in the Northern Great Plains of North America. J. Ecol. 49:135–167.

Dorn, R.D. 1984. Vascular plants of Montana. Mountain West Publ., Cheyenne, WY.

Dorn, R.D. 2001. Vascular plants of Wyoming, 3rd ed. Mountain West Publ., Cheyenne, WY.

Environmental Systems Research Institute (ESRI). 2011. ArcGIS desktop, version 10.0. Redlands, CA.

Fenneman, N.M. 1916. Physiographic subdivisions of the United States. Proc. Natl. Acad. Sci. U.S.A. 3:17–22.

Flora of North America Editorial Committee, eds. 1993+. Flora of North America north of Mexico. Oxford Univ. Press, New York.

Fullerton, D.S. and R.B. Colton. 1986. Stratigraphy and correlation of the glacial deposits on the Montana plains. Quatern. Sci. Rev. 5:69–82.

Goff, G.F., G.A. Dawson, and J.J. Rochow. 1982. Site examination for threatened and endangered plant species. Environm. Managem. 6:307–317.

Great Plains Flora Association (GPFA). 1977. Atlas of the flora of the Great Plains. Iowa State Univ. Press, Ames.

Great Plains Flora Association (GPFA). 1986. Flora of the Great Plains. Univ. Press Kansas, Lawrence.

Hansen, P.L., R.D. Pfister, K. Boggs, B.J. Cook, J. Joy, and D.K. Hinckley. 1995. Classification and management of Montana's riparian and wetland sites. Montana Forest Conservation Exp. Sta. Misc. Publ. No. 54.

Hartman, R.L. 1992. The Rocky Mountain Herbarium, associated floristic inventory, and the flora of the Rocky Mountains project. J. Idaho Acad. Sci. 28:22–43.

Hartman, R.L. and B.E. Nelson. 2008. General information for floristics proposals [The Boiler Plate]. URL: http://www.rmh.uwyo.edu. Accessed 7 Jan 2013.

Hartman, R.L., B.E. Nelson, and B.S. Legler. 2009. Rocky Mountain Herbarium specimen database. URL: http://www.rmh.uwyo.edu. Accessed 27 Mar 2013.

Jensen, F.S. and H.D. Varnes. 1964. Geology of the Fort Peck area, Garfield, McCone and Valley counties, Montana. Profess. Pap. U.S. Geol. Surv. 414-F:F1–F49.

Johnson, J.R. and G.E. Larson. 2007. Grassland plants of South Dakota and the Northern Great Plains. South Dakota State Univ., Coll. Agric. Biol. Sci., South Dakota Agric. Exp. Sta., Brookings.

Kartesz, J.T. 2013. The Biota of North America Program (BONAP). Taxonomic data center. Chapel Hill, N.C. [maps generated from Kartesz, J.T. 2013. Floristic synthesis of North America, version 1.0. Biota N. Amer. Program. (in press)]. URL: http://www.bonap.net/tdc. Accessed 4 Apr 2013.

Kesonie, D.T. and R.L. Hartman. 2011. A floristic inventory of Grand Teton National Park, Pinyon Peak Highlands, and vicinity, Wyoming, U.S.A. J. Bot. Res. Inst. Texas 5:357–388.

Klassen, R.W. 1994. Late Wisconsinan and Holocene history of southwestern Saskatchewan. Canad. J. Earth Sci. 31: 1822–1837.

Knechtel, M.M. 1959. Stratigraphy of the Little Rocky Mountains and encircling foothills, Montana. Bull. U.S. Geol. Surv. 1072-N:723–752.

Knight, D.H. 1994. Mountains and plains: the ecology of Wyoming landscapes. Yale Univ. Press, New Haven, CT.

Kruckeberg, A.R. 2002. Geology and plant life: the effects of landforms and rock types of plants. Univ. Washington Press, Seattle.

Kuhn, B., B.E. Nelson, and R.L. Hartman. 2011. A floristic inventory of the Cimarron National Grassland (Kansas) and the Comanche National Grassland (Colorado). J. Bot. Res. Inst. Texas 5:753–772.

Lavin, M. and C. Seibert. 2011. Great Plains flora? Plant geography of eastern Montana's lower elevation shrub-grass dominated vegetation. Nat. Resources Environm. Issues 16:3–14.

Lesica, P. 2012. Manual of Montana vascular plants. BRIT Press, Fort Worth, TX.

Lesica, P.L. and T.H. DeLuca. 2000. Sweetclover: a potential problem for the Northern Great Plains. J. Soil Water Conservation. 55:259–260.

Lesica, P. and C. Marlow. 2013. Green ash woodlands: a review. Montana State Univ. Ext. Res. Bull. No. 4601.

Lukas, L.E., B.E. Nelson, and R.L. Hartman. 2012. A floristic inventory of vascular plants of the Medicine Bow Mountains, southeastern Wyoming, U.S.A. J. Bot. Res. Inst. Texas 6:759–787.

Mackie, R.J. 1970. Range ecology and relations of mule deer, elk, and cattle in the Missouri River Breaks, Montana. Wildlife Monogr. 20:3–79.

Marshak, S. 2005. Earth: portrait of a planet, 2nd ed. W.W. Norton and Co., New York.

McArthur, E.D. 1999. Sagebrush systematics and distribution. In: Entwistle, P.G., A.M. DeBolt, J.H. Kaltenecker, and K. Steenhof, eds. Proceedings: Sagebrush steppe ecosystem symposium, Boise, ID. Bur. Land Managem. Publ. No. BLM/ID/PT-001001+1150. Pp. 9–14.

Mincemoyer, S. 2012. Checklist of Montana vascular plants: dated February 14, 2012. Montana Nat. Heritage Program. URL: http://mtnhp.org/Docs/021412_MT_ Plant_List.pdf. Accessed 11 Apr 2012.

Montana Natural Heritage Program (MTNHP). 2010. Montana land cover framework data accessed via the Montana GIS portal. URL: http://gisportal.msl.mt.gov/geoportal/catalog/main/ home.page. Accessed 22 Apr 2012.

Montana Natural Heritage Program (MTNHP). 2012a. Montana ecological systems field guide. URL: http://fieldguide.mt.gov/displayES_LCLU.aspx. Accessed 25 Apr 2012.

Montana Natural Heritage Program (MTNHP). 2012b. Plant species of concern report. URL: http://mtnhp.org/SpeciesOfConcern/?AorP=p. Accessed 23 Apr 2012.

Montana Noxious Weed Program (MNWP). 2010. Montana noxious weeds list. Montana Dept. Agric. URL: http://agr.mt.gov/agr/Programs/Weeds/PDF/weedList2010.pdf. Accessed 15 Apr 2012.

Montana State University Herbarium (MONT). 2013. Montana State University Herbarium specimen data accessed via the Consortium of Pacific Northwest Herbaria. URL: http://www.pnwherbaria.org/data/search.php. Accessed 4 Apr 2013.

Munn, L.C. and M.M. Boehm. 1983. Soil genesis in a natrargid-haplargid complex in northern Montana. J. Soil Sci. Soc. Amer. 47:1186–1192.

National Climatic Data Center (NCDC). 2012. Climate date online for Glasgow Intl. Airport (station:GHCND:USW00094008). URL: http://www.ncdc.noaa.gov/cdo-web/#t=secondTabLink. Accessed 3 Apr 2012.

National Weather Service (NWS). 2012. Annual climate summary for Glasgow, Montana. URL: http://www.nws.noaa.gov/climate/local_data.php?wfo=ggw. Accessed 3 Apr 2012.

Neldner, V.J., D.C. Crossley, and M. Cofinas. 1995. Using geographic information systems (GIS) to determine the adequacy of sampling in vegetation surveys. Biol. Conservation 73:1–17.

Peel, M.C., B.L. Finlayson, and T.A. McMahon. 2007. Updated world map of the Köppen-Geiger climate classification. Hydrol. Earth Syst. Sci. 11:1633–1644.

Phillips, H.W. 2003. Plants of the Lewis and Clark Expedition. Mountain Press Publ., Missoula, MT.

PRISM Climate Group (PRISM). 2004. Average annual precipitation, average daily maximum temperature and average daily minimum temperature data (1971–2000). Oregon State Univ. URL: http://prism.oregonstate.edu. Accessed 26 Nov 2011.

Reif, B., J. Larson, B. Jacobs, B.E. Nelson, and R.L. Hartman. 2009. Floristic studies in north central New Mexico, U.S.A. The Tusas Mountains and the Jemez Mountains. J. Bot. Res. Inst. Texas 3:921–961.

Roberts, D.W. 1980. Forest habitat types of the Bear's Paw Mountains and Little Rocky Mountains. M.S. thesis. Univ. of Montana, Missoula.

Rydberg, P.A. 1932. Flora of the prairies and plains of central North America. New York Bot. Gard., New York.

Singh, J.S., W.K. Lauenroth, R.K. Heitschmidt, and J.L. Dodd. 1983. Structural and functional attributes of the vegetation of northern mixed prairie of North America. Bot. Rev. (Lancaster) 49:117–149.

Strong, W.L. and L.V. Hills. 2005. Late-glacial and Holocene palaeovegetation zonal reconstruction for central and north-central North America. J. Biogeogr. 32:1043–1062.

Takhtajan, A. 1986. Floristic regions of the world. Univ. California Press, Berkeley.

Thompson, L.S. and J. Kuijt. 1976. Montane and subalpine plants of the Sweetgrass Hills, Montana, and their relation to early postglacial environments of the Northern Great Plains. Canad. Field-Naturalist 90:432–448.

University of Montana Herbarium (MONTU). 2013. University of Montana Herbarium specimen database. URL: http://herbarium.dbs.umt.edu/database/Default.aspx (4 Apr 2013).

U.S. Department of Agriculture (USDA). 2012. The PLANTS database. Nat. Resources Conservation Serv., Natl. Pl. Data Center. Greensboro, NC. URL: http://plants.usda.gov. Accessed 13 Apr 2012.

U.S. Geological Survey (USGS). 1999. Digital representations of tree species range maps from "Atlas of United States trees" by E.L. Little, Jr. (and other publications). URL: http://esp.cr.usgs.gov/ data/atlas/little/. Accessed 31 Oct 2012.

U.S. Geological Survey (USGS). 2009. One-arc-second national elevation dataset accessed via the national map seamless server viewer. URL: http://seamless.usgs.gov/index.php. Accessed 27 Nov 2011.

Vuke, S.M., K.W. Porter, J.D. Lonn, and D.A. Lopez. 2007. Geologic map of Montana. Montana Bur. Mines Geol. (map scale 1:500:000).

Western Regional Climate Center (WRCC). 2012. 1981–2010 monthly climate summary for Zortman, Montana (NOAA coop. station 249900). URL: http://www.wrcc.dri.edu/cgi-bin/ cliMAIN.pl?mt9900. Accessed 3 April 2012.

Wilson, M.R. and T.K. Kyser. 1988. Geochemistry of porphyry-hosted Au-Ag deposits in the Little Rocky Mountains. Econ. Geol. 83:1329–1346.